FARM

Food and Agriculture Regional Model

II LIVESTOCK

Agriculture Canada

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FARM
FOOD AND AGRICULTURE REGIONAL MODEL
II 1 LIVESTOCK

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FOREWORD

This publication is one of a series of ten forming *Food and Agriculture Regional Model (FARM)*, which consists of the following:

Part I	*Overview*,
Part II	*Commodity Components:*
	Livestock,
	Grains and Oilseeds,
	Dairy,
	Poultry and Eggs,
	Retail Demand,
	Accounting,
Part III	*Estimation Results*,
Part IV	*Computer Software*, and
Part V	*Data Appendix*.

For an introduction to, and a general description of the model in its entirety, see Part I, *Overview*.

The results presented in this report relate to the livestock component only and treat other sectors of the model as exogenous.

The results reported are an update of the earlier version of the technical report released on a limited basis in 1980. The model is currently used on a regular basis in preparing outlook information in Agriculture Canada.

This report is preliminary and unedited and should not be quoted without the author's permission. The views in the report do not necessarily represent the views of the Government of Canada.

This report is prepared by P. Charlebois.

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II 1 LIVESTOCK COMPONENT

II 1.1 Introduction

This section of the technical report describes the beef and pork sectors of the agriculture sector model. The particular version is a provisional form of the livestock component of the model. This component is disaggregated by product, region and stages in the marketing process. Because the industry is complex, involves variable length production processes and results in various types of output, a model of the industry requires considerable detail. Interactions with other commodities are abundant. The livestock sector competes with the crops and dairy sectors for resources, but also uses output of these sectors (grain and calves) as major inputs. While direct government intervention with price or production policies has been limited, the price and trade restraints from 1973 to 1975 had significant long-term effects on supply. This occured because a basic characteristic of the beef sector is the internally generated cycle in prices and production of 8–12 years and the long feedback effects which are part of the supply response relationships. Trade in livestock products between Canada and the United States is important and has been relatively free (except for limited periods). Also, the production relationships vary substantially within Canada. Explicit specifications of markets for Eastern and Western Canada is therefore required. In this version, the U.S. livestock sector is taken as exogenous.

The main objective of the livestock component is to provide reliable short-to-medium-term forecasts for quarterly livestock prices, production, consumption, stocks, and trade variables at several stages in the production-marketing process for two regions and Canada. As well, the basic structural elements of the model should permit examination of a number of policy questions related to trade, transportation, stabilization, and other policies for the livestock sector.

The model of the livestock sector (beef and pork) is based on a three-level market system with demand derived from the retail level through a wholesale and processing sector to the farm level. This derived demand is interacted with a farm supply and inventory block. Trade flows of both meat and animals is permitted between the regions and corresponding price linkages are provided.

II 1.2 Characteristics of the red-meat sector

II 1.2.1 Industry setting[1]

Beef production in Canada is based on a herd of 12.47 million head of cattle and calves (including dairy cattle), and generated approximately 3.5 billion dollars in farm cash receipts (i.e., 19 percent of the total) in 1981.[2] Exports of cattle, beef and veal, tallow, raw hides, breeding stock and semen in 1981 amounted to 463 million dollars with imports (excluding any semen) amounting to 355.6 million dollars.[3] Federally and Provincially inspected cattle slaughter in 1981 was 3.29 million head while total per capita beef consumption was about 90.2 pounds.[4] In 1978, beef consumption represented approximately 8.7 percent of total food expenditures.[5]

There were 9.3 million hogs on farms in Canada in January 1, 1982, 66 percent of which were in Ontario and Quebec.[6] Hog sales generated approximately 1.6 billion dollars in farm cash receipts (i.e., 8.8 percent of the total)[7] in 1981. Exports of breeding stock, slaughter hogs, pork and lard totalled 416 million dollars. While imports were valued at 54.2 million dollars, in that same year.[8] In 1981 slaughter totalled 13.04 million hogs, a large part of which was converted to processed pork products.[9] Pork consumption in 1981 was about 69.4 pounds per person and in 1978 it represented approximately 5.1 percent of total food expenditures.[10]

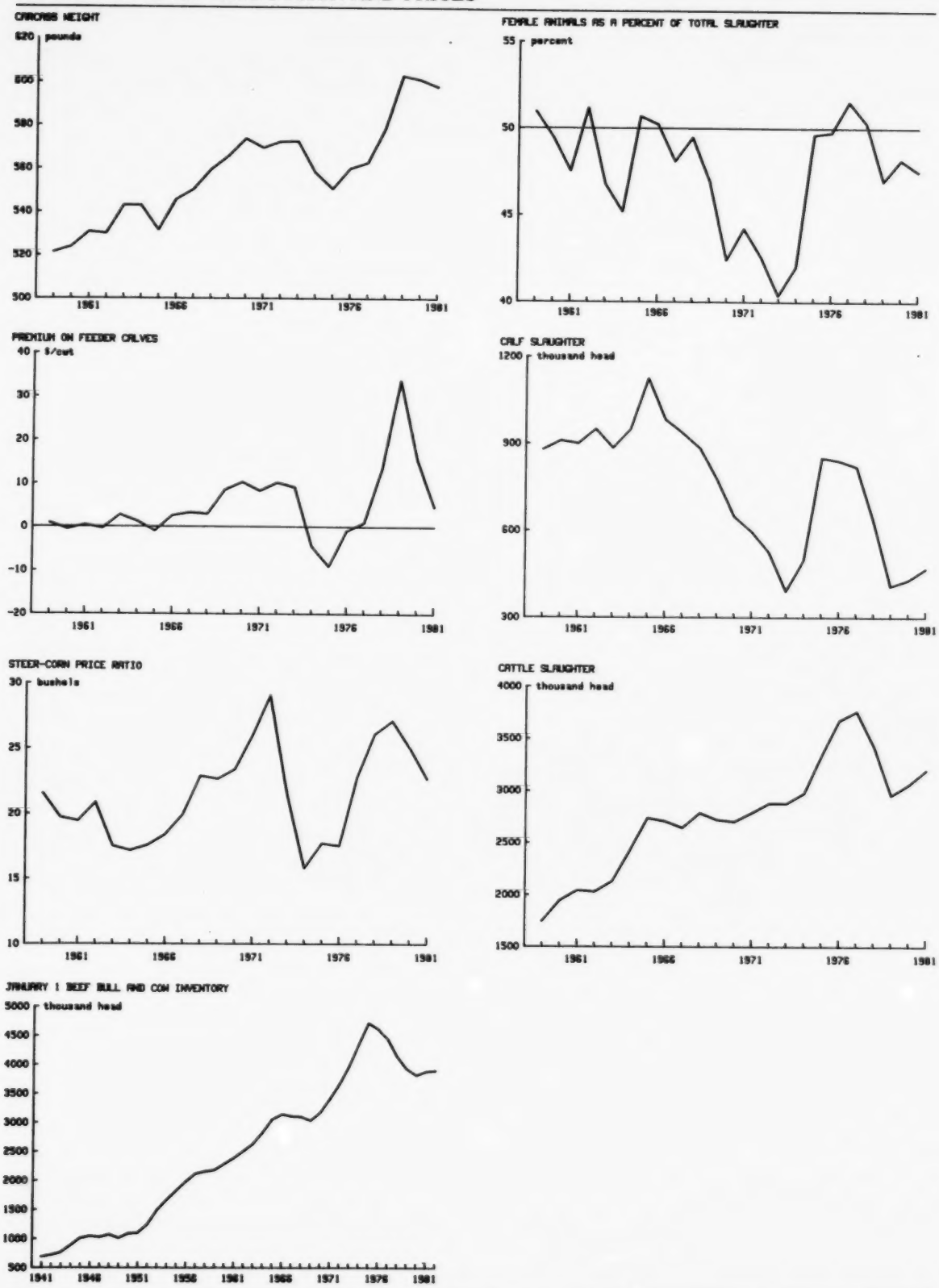
Slaughtering and meat processing is one of the largest manufacturing industries in Canada. It consisted of some 524 establishments and added 1109 million dollars to the value of products in 1979. Its total wage bill amounted to 564 million dollars in 1979.[11]

The livestock production-marketing system has been described and documented elsewhere (see, for example, MacAulay, 1966 and 1968, Beef Inquiry 1966, Chin *et al* 1974, Petrie *et al* 1973). To provide a setting for the model specification, a brief review of the main elements of livestock production, marketing and trade is outlined below.

II 1.2.1.1 BEEF PRODUCTION

The production of beef is begun by investment in the breeding herd. Such investment decisions are related mainly to expected prices of feeder calves and alternative production opportunities. The latter differ greatly between Western and Eastern Canada. In the west, the grain sector represents the main opportunity cost through the use of land for pasture or grain

FIGURE 1.1 BEEF PRODUCTION AND PRICES



production. In the east, beef and pork are the main alternative enterprises to dairy, while surplus dairy calves may add to feeder calf supplies, depending on relative prices of veal. The grain market also influences the beef sector through calf prices which reflect feed costs since feedlot demand shifts with variations in grain prices. Restrictive grain marketing quotas in the west have also caused livestock to become an outlet for grain. Feedlots in the east are generally corn silage based and grain prices are not so quickly reflected in feeder demand.

The long biological lag of at least two years between breeding investment and beef production is a major element creating the internally generated price and production cycles of about 8 to 12 years. Higher beef prices are soon reflected in higher calf prices resulting from increased feedlot demand. Female calves are then held back from slaughter to augment breeding herds. This investment activity reduces beef supply for 2–3 years further driving up prices and increasing investment incentives. Eventually, the larger breeding herd produces an increased supply and the cycle reverses.

These cyclical processes are illustrated in Figure II 1.1 showing long-term movements in various components of beef production and prices. These figures provide evidence not only of the cyclical pattern, but also illustrate the temporal relationships among the various stages in production and associated prices. Also worthy of note is the relative instability of production and prices in the 1970's. These occurred largely in response to the extreme variations in grain prices between the late 1960's and mid-1970's.

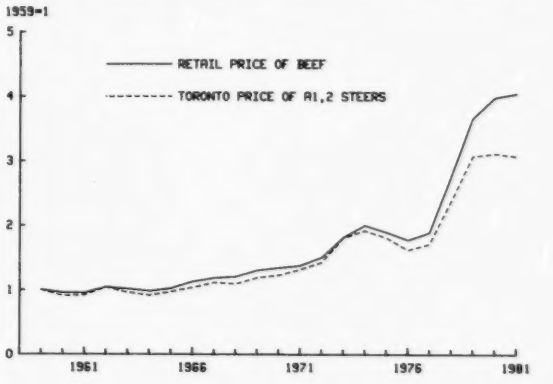
II 1.2.1.2 BEEF MARKETING

Trade plays a more important role in the Canadian beef sector than volume data would indicate. Trade with the United States may occur in the form of calves, fed cattle, cows or fresh beef. Canada's other major trade is in frozen beef from Oceania. With the United States market approximately thirteen times greater than Canada, Canada faces an almost elastic export supply and import demand. Since trade occurs at various market levels in the production process, large exports of calves in one quarter may result in large imports of slaughter cattle 2–4 quarters later. In effect, trade constrains Canadian prices to within a narrow band about United States prices (import "ceiling" and the export "floor").

When normal free trading patterns are disrupted, as occurred in 1973–1975 (see Appendix IIA), different regional market relationships occur. As well, fluctuations in the value of the Canadian dollar may directly affect domestic prices. Frozen Oceanic beef supplies a low grade beef but Canada also exports fresh low grade beef to the United States. Both markets are now protected by quotas.

Most beef is consumed in a fresh form within one to two weeks of slaughter and wholesale prices closely follow basic farm prices when by-product prices are considered. Retail prices, however, may deviate from this close relationship because of the importance of beef in retail promotions, and price levelling or price leadership practices of large retailers. That price can also be affected by cost such as wages, energy and capital. As can be seen from Figure II 1.2, the 1973 retail price index to Toronto steer price index ratio was equivalent to the one in 1959. Since the acceleration of inflation in 1973 the gap has widened and has remained at high levels since 1979.

FIGURE 1.2 RETAIL PRICE OF BEEF VERSUS TORONTO PRICE OF A1.2 STEERS



II 1.2.1.3 PORK PRODUCTION AND MARKETING

The pork production process has similar characteristics to beef but several important differences exist. Biological lags are shorter creating price and production cycles of a much shorter duration but with more extreme fluctuations. These are obvious in Western Canada where surplus grain has traditionally been marketed through hogs.

A large percentage of pork is consumed in processed form. As a result, pork stocks are an important element in determining market prices and the disappearance of pork.

Trade occurs mainly in the form of pork products with small specialty markets creating simultaneous two-way product flows with the United States market. Japan has been the main off-shore market for pork with some of this product moving under long-term contracts.

Recent trends in the production of pork and hog prices are contained in Figure II 1.3. The data illustrates a shorter production and price cycle for pork than for beef. Furthermore, while pork production generally trended upward during the late 1960's and early 1970's, it declined in between 1973 and 1976. This again occured in response to reçord high grain prices. It then started a sustained and sharp increase, particularly in the East, until reaching a plateau in 1980. In the last 11 years, Eastern Canada's share went from 53.56 to 71.55 percent. The industry is now less volatile because a lot of those new Eastern producers are vertically integrated. In 1981, pork production was approximately 33.5% bigger than in 1971.

FIGURE 1.3 PORK PRODUCTION AND PRICE OF INDEX 100 HOGS

II 1.2.2 Scope of livestock component

The livestock component is designed to represent the major activities in the beef and pork industries. Exogenous to this component (but endogenous to the whole model) are the variables from the grain and dairy components of the model and exogenous to both are the variables such as general macroeconomic variables. The endogenous variables cover five main areas: (1) consumption, (2) production, (3) cold storage stocks of meat and inventories of animals on farms, (4) trade in animals and meat, and (5) prices of animals and meat (see Table II 1.2.1).

For both beef and pork, the model includes three main regions: Western Canada, Eastern Canada and Canada (identities). Trade with the rest of the world (excluding U.S.A.) is considered to be exogenous. Because of the very different relationships between the grain sector and the livestock sectors of Western and Eastern Canada these two regions were separated. As indicated earlier, the United States has a very important influence on Canadian livestock markets both in terms of price determination and trade flows.

The retail demand for livestock products is discussed in more detail in the Retail Demand Block (Section II.5). A single Canadian demand equation is used for all beef and similarly for pork. This is necessary since time series on the disappearance of beef and pork are very difficult to derive on a regional basis.

The wholesale and farm market levels are more disaggregated because of the availability of regional slaughter data. Three categories of live cattle are used — steers, heifers, and cows and bulls, since economic behaviour differs for each category. The total production of beef and pork is the product of the number of head slaughtered and carcass weights. Again, number slaughtered and carcass weight are separated since they are determined by different factors.

Cold storage stocks of beef and pork are both included. For beef, however, only frozen or chilled beef is included, not processed meat. Inventories of the three types of beef animals are specified because of their importance in forecasting supply. For pigs, however, only total hog are used.

Price transmission relationships between market levels are more extensive for beef than pork. In the case of beef, retail, wholesale, farm and feeder cattle market levels are included with transmission equations linking prices at the various level. For pork, the production process modelled is simplified to include only retail and wholesale market levels.

Trade between Canada and the United States is included on a net basis for a single category of beef and pork and for the three categories of live cattle. Trade in live hogs is taken to be exogenous since the numbers are usually very small.

The provisional model of the livestock component is 91 equations with 62 for beef and 29 for pork.

TABLE II 1.2.1. CLASSIFICATION OF ENDOGENOUS VARIABLES IN THE LIVESTOCK COMPONENT

Market Level	Type of Variable				
	Demand	Supply	Cold Storage Stocks and Inventories	Trade	Prices
Beef Component					
Retail	per-capita consumption				retail beef price
Wholesale	total beef disappearance	total beef production cattle carcass weight	beef stocks	beef trade	wholesale carcass price
Farm	steer slaughter	steer marketing	steer inventory	steer trade	steer price
	heifer slaughter	heifer marketings	heifer inventory	heifer trade	heifer price
	cow and bull slaughter	cow and bull marketings	cow and bull inventory	cow and bull trade	cow price
Pork Component					
Retail	per-capita consumption				retail pork price
Wholesale	total pork disappearance	total pork production hog carcass weight	pork stocks	pork trade	price of index 100 hogs
Farm	hog slaugther	hog marketings	hog inventory	hog trade	

II 1.3 Theoretical motivation

II 1.3.1 Introduction

This section outlines the economic rationale on which the structural representation of the livestock component is based. The motivation is outlined for cattle inventories, livestock supply or marketings and trade relationships. For cold storage stocks, retail demand and vertical price linkages, the theoretical material is provided in other sections of the report.

II 1.3.2 Cattle inventories

Changes in the size of the breeding herd is one of the fundamental elements creating variations in beef production and prices. Producers' decisions reflect two competing uses for female animals — slaughter for beef and retention for future production of calves. Producers will invest in breeding stock (retain cows and add heifers) when the expected discounted present value of future receipts from the sale of feeder calves exceeds a female's value for beef (salvage value). The higher the expected value of calves, the greater the investment in the breeding herd and correspondingly the lower the short run supply of beef. In the longer run, however, the increased size of the breeding herd will generate a larger beef supply.

At the same time, beef producers also consider the return from alternative uses of these resources, which may be used in beef production. Generally opportunities are limited, but in the west grain production and export are alternatives to production of feeder calves and finish beef respectively, while in the east it is largely the dairy industry or beef finishing that provides the main alternative.

Inventories of heifers and especially steers largely reflect potential future marketings. Since sow inventories change rapidly, and a large number of piglets are produced from each sow, they are difficult to use as a measure of future supplies.

II 1.3.3 Livestock supply

II 1.3.3.1 BEEF SUPPLY

The production relationships for beef are complex because of the variations in types of inputs used and types of outputs produced and because of the long biological lags involved. Supply of beef is affected by both numbers slaughtered and their carcass weight, both of which respond to market incentives.

Numbers marketed are primarily determined by calf supplies available for finishing. These reflect earlier cow inventory decisions and hence numbers of calves born and current breeding inventory decisions as to the numbers of females to be withheld from slaughter. Thus, the greatest variation in supply occurs with female (heifers and cows) slaughter. Also, the dairy herd may supply calves depending on herd replacement rates and veal prices. Short term variations in the numbers marketed may also be brought about by the incentive to feed to heavier weights when slaughter cattle prices rise and/or feed costs fall.

Carcass weights vary to a considerable extent with the length of time on feed and the intensity of the feeding. The optimal carcass weight depends on the marginal costs of adding an additional pound of gain versus its cost, taking into account the fact that livestock become less efficient feed converters at heavier weights. Thus, feed costs and beef prices are important influences on the optimal slaughter weights. As well, optimal slaughter weights occur at quite different levels for steers, heifers and cows.

II 1.3.3.2 PORK SUPPLY

Pork supply is based on a simpler response function than beef and reflects mainly expected input and output prices. In the short run, the major variable cost is feed. In the west, opportunity costs of feeding pigs are affected, in addition to grain prices, by the availability of delivery quotas for grain. Consequently, Western Canadian supply response is more variable and reflects the state of the grain markets. Pork production is the product of two variables, the average carcass weight of hogs largely determined by the economic incentives built into the grading system in Canada, and the number of hogs slaughtered.

II 1.3.4 Trade

The determination of trade flows for the component is based on the principles outlined for spatial equilibrium models (see Takayama and Judge [1964], Lee and Seaver [1973], and MacAulay [1976] and [1978]). In a spatial equilibrium framework, perfect arbitrage is generally assumed and trade therefore holds prices to within a fixed differential (i.e., between an import ceiling and export floor). In practice, however, there is an imperfect adjustment to changing regional prices due to the adjustment costs involved and the increased transport costs for more distant sources of supply. More distant sources will be used as the volume of trade increases (i.e., supplies are not available at a fixed point). Work by Bordo and Choudhri [1976] indicates that for traded goods the process of arbitrage was sluggish and probably subject to increasing costs in the short run. This suggests a partial adjustment mechanism may be involved in the adjustment of inter-regional prices.

For beef, trade can occur in the form of feeder calves, slaughter cattle, or beef. Hence, flows of one category affect supplies available in others and may generate reverse flows in later periods. For both beef and pork trade flows across the United States–Canada border periodically reverse in direction. Account must be taken of this phenomenon and an allowance made for the switching between an import ceiling and an export floor. The effects of changes in exchange rates also have to be incorporated into the system of spatial equations.

II 1.3.5 Price linkages, stocks and demand

The retail demand theory is described in more detail in the Retail Demand Section (Section II.5). Briefly, demand is based on a conventional relationship with beef or pork being determined by their own price, prices of close substitutes, population, level of consumer disposable income and season of the year. The demand equations are estimated on a per capita bases.

Stock holding behaviour is described in the Overview Section (Section II.1). Cold storage stocks of beef and pork are held for transactional purposes (i.e., a percentage of the amount distributed), and speculative purposes, (i.e., the cost of holding stocks is expected to be less than the rise in price the following period). These motives for holding stocks can be represented by quantity and price variables. The latter was not found to play an important role in the determination of stock levels.

The principle behind the vertical price linkage relationship is also more fully explained in the Overview Section. The prices between stages in the marketing process reflect processing costs under the assumption of perfect competition. At each level, however, these are market determined prices and short run supply constraints or surpluses may affect price spreads temporarily. As well, firm behaviour may distort the relationships, particularly at the retail level where firms use beef as a loss leader, do price levelling, and create some product differentiation.

II 1.4 Structure of the livestock component

II 1.4.1 Block structure

The block structure for the beef and pork components is similar. Pork, however, does not include as many live animal categories. Figure II 1.4 illustrates the production-marketing process for one region. Each of the two regions has a similar structure and are connected to the U.S.A. through the spatial price linkage equations. From the live cattle and hog inventories on farms, farm marketing are generated. The live animal or farm price is generated by the interaction of producers' supply and processors' demand. At the farm level animal trade takes place and at the processing level meat trade takes place. Processors or wholesalers hold meat stocks and wholesale prices are established by the interaction of wholesaler supply and retailer demand including the effects of stocks demand. Retail prices are established by consumer demand and retail supply and the various vertical and spatial price linkages that interconnect the market levels and regions. Some of the price transmission equations that are involved and the feedback of the feeder calf price on the determination of cattle inventories and marketings are also illustrated in Figure II 1.4.

II 1.4.2 Equation specification

A detailed listing of equations for the livestock component is given in Appendix IIB. This section will outline the specification for representative equations from the beef and pork models. Similar specifications are used for each of the two regions. Pork is also similar in structure to beef and only differences between the two commodities will be highlighted. Table 1.4.2.1 presents the 30 most important equations in the livestock model without specifying details for heifers and cows and bulls. Only selected groups of these equations will be discussed in the following sections.

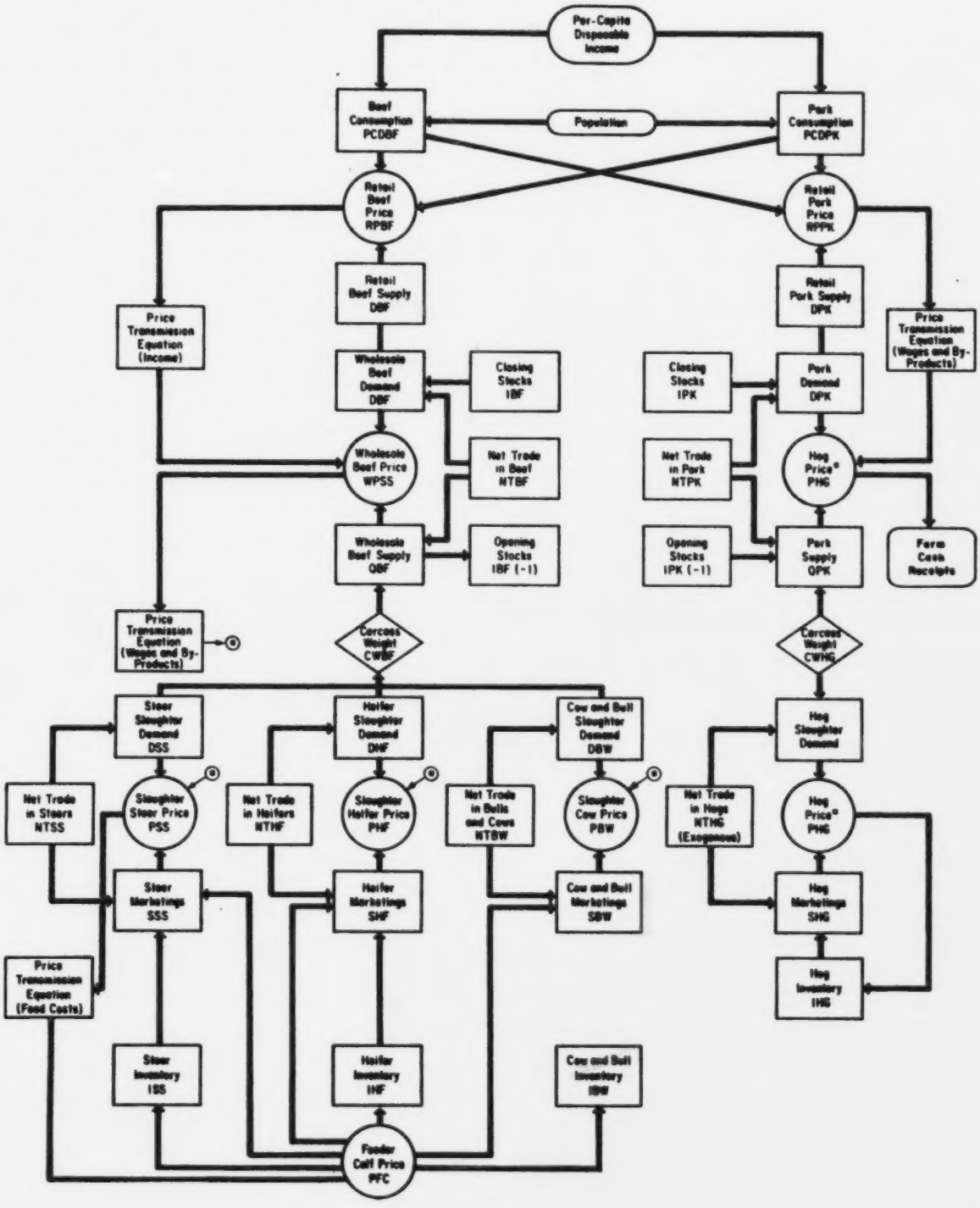
II 1.4.2.1 FARM INVENTORIES OF ANIMALS

The main driving force on the supply block of the beef component is the inventory of beef cows and bulls (IBW). The number on farms is determined by the net outcome of decisions related to cow and bull slaughter, heifers bred for herd replacement and the number of animals traded between regions. Slaughter is determined elsewhere in the model while the main economic behaviour to be explained is that of the number of breeding heifers kept for replacements purposes. This is assumed to depend on the expected feeder calf price when heifers are bred. If the expected feeder calf prices is based on the current period, then a lag of approximately three quarters is needed (PFC(−3)) since bred cows are rarely slaughtered. Slaughter heifers prices and interest rate (PHF(−3) RFC(−3)) reflect the opportunity cost of entering the heifer in the herd, cow slaughter measures the direct effect on closing cow inventory, while the ratio of heifer marketings to steers marketings is used to keep track of which stage of the cycle the industry is in. When the ratio is greater than 1.05 the industry is in a liquidating phase and the inverse when it is lower than .95.

Inventory demands for steers (ISS), and heifers (IHF), are related, with a lag of six to nine quarters, to the inventory of cows and bulls to reflect the number of calves born. With the exception of steers inventory in Western Canada, adjustments are made for the effects of steer and heifer slaughter and the determinants of the economic decisions which allocate calves between slaughter or held to become part of heifer and steer inventories. These decisions are assumed to be based on expected feeder calf prices at the time calf slaughter decisions are made (various lags are used). For heifers, there is the additional flow of heifers becoming cows which will be explained by much shorter lags on the feed calf price (PFC) and the slaughter heifer price (PHF). In the east, corn prices and a dummy variable for 1974Q2 (unexplained behaviour) are also included in steer inventories. The lag structure varies between categories and regions.

As was the case with the beef component, the inventory of hogs is the main driving force on the supply block of the pork component. In Western Canada, a farm inventory of grains variable is needed since surplus grain has traditionally been marketed through hogs. The off-board price of barley is also included to take into account the opportunity cost of feeding hog with barley (OPBA3(−2)). In the East the farm prices of corn (FPC02(−2)) and interest rate (RFC3(−2)) are the two major cost of production items. The second is especially true now because a lot of loans contracted in the period 1976–77–78 will have to be renegotiated in a period of much higher interest rates. A dummy variable was also included for vertical integration practices and governmental aid in the province of Quebec over the period 1977Q1 to 1981Q4.

FIGURE II 1.4 STRUCTURE OF THE BEEF AND PORK COMPONENTS



*The farm price for hogs, PHG, was used to represent the wholesale price in the model.

TABLE II 1.4.2.1. REPRESENTATIVE SPECIFICATION OF THE BEEF AND PORK COMPONENTS[a]

(1) Inventory demand for cows and bulls

IBW1 = f[JS_i, PFC1(−3), SBW1, PHF1(−3), IBW1(−1), RFC3(−3), SHF1(−6)/SSS1(−6)]

IBW2 = f[JS_i, PFC2(−3), FPCO2(−3), PHF2(−3), SHF2(−6)/SSS2(−6), IBW2(−1), SBW2]

(2) Inventory demand for steers

ISS1 = f[JS_i, JS_i*IBW1(−6)]

ISS2 = f[SSS2, ISS2(−1), IBW2(−9), PFC2(−7), FPC02(−2)]

(3) Steer Marketings

SSS1 = f[JS_i, JS_i*IBW1(−8)]

SSS2 = f[PSS2(−8), FPCO2(−9), PFC2(−7), SSS2(−1), ISS2(−1)]

(4) Steer-to-feeder calf price transmission Text[b]

PFC1 = f[JS_i, PSS1(−1), OPBA3(−1), PFC2]

PFC2 = f[PSS2(−1), FPCO2(−1), PFC2(−1)]

(5) Region 1-to-region 2 steer price transmission

NT1BF2 = f[JS_i, NT1BF2(−1), WPSS2, WPSS1]

(6) Average carcass weight for all cattle slaughtered

CWBF3 = f[JS_i, PSS(−2), OPBA(−2), CWBF3(−1)]

(7) Wholesale-to-farm steer price transmission

PSS − PSS(−1) = f[JS_i, WPSS − WPSS(−1), DSS − DSS(−1), WAPK − WAPK(−1), VBBF − VBBF(−1)]

(8) Cold storage stocks demand for beef

IBF = f[JS_i, WPSS, QBF, IBF(−1)]

(9) Wholesale steer-to-retail beef price transmission

RPBF = f[JS_i, WPSS, IBF, (.2*WA3 + PBOIL3), ER34, RPBF(−1)]

(10) Per capita consumption demand for beef (see Demand Component)

RPBF = f[JS_i, PCBF, RPBF(−1), RPPK, PCDY]

(11) Beef demand identity

DBF = f[PCBF*POPN]

(12) Beef production identity

QBF = f[CWBF*(DHF + DSS + DBW)/1000]

(13) Beef supply-demand balance identity

DBF = QBF + IBF(−1) − IBF − NTBF

(14) Steer supply-demand balance identity

DSS = SSS − NTSS

(15) Hog inventory Western Canada

IHG1 = f[JS3*FIGR, PHG1(−2), OPBA3(−2), IHG1(−1)]

(16) Hog inventory Eastern Canada

IHG2 = f[PHG2(−2), RFC3(−2), FPCO2(−2), IHG2(−1), DQUE]

(17) Hog marketings

SHG = f[JS_i, IHG(−1), SHG(−1)]

(18) Cold storage stocks demand for pork

IPK = f[JS_i, QPK, IPK(−1)]

(continued)

TABLE II 1.4.2.1. REPRESENTATIVE SPECIFICATION OF THE BEEF AND PORK COMPONENTS[a] (concluded)

(19) Per capita consumption demand for pork (see Demand Component)

RPPK = f[JS_i, PCPK, RPBF, PCDY, RPPK(−1)]

(20) Wholesale-to-retail pork price transmission

RPPK = f[JS_i, PHG, IPK(−1), (.2*WA3 + PBOIL3), ER34, RPPK(−1)]

(21) Average carcass weight for all hogs slaughtered

CWHG = f[JS_i, PHG(−1), 0PBA(−3), CWHG(−1)]

(22) Region 1-to-region 2 hog price transmission Text[b]

PHG1 = f[JS_i, PHG2, NT1PK2, PHG1(−1)]

(23) Pork demand identify

DPK = f[PCPK*POPN]

(24) Pork production identify

QPK = f[DHG*CWHG]

(25) Pork supply-demand balance identity

DPK = QPK + IPK(−1) − IPK − NTPK

(26) Hog supply-demand balance identity

DHG = SHG − NTHG

[a] Definitions for the variables are given in Appendix IIB with numbers representing regions. A complete model listing is also given.

[b] An exchange rate between countries would be included in the interregional price transmission equations.

II 1.4.2.2 CATTLE AND HOG MARKETINGS

The specification of cattle marketings (except steers in Western Canada) relies on the notion that the opening inventory of heifers (IHF(−1)), steers (ISS(−1)), cows and bulls (IBW(−1)), will provide a measure of the number available for marketing in the current period, but that the age and weight composition of this inventory will be determined by a variety of expected prices based on lagged prices such as grain prices, feeder calf prices (PFC) and slaughter cattle prices (PSS, PHF, PBW). In some cases, because of problems with inventory data it was found appropriate to replace the opening inventory with a long lag on beef cow and bull numbers to represent the available supply. Short term effects of current period grain prices on cattle marketings were also specified in some equations.

The specification of hog marketings relies solely on the notion that the opening inventory IHG(−1) will provide a measure of the number of animals available for marketing in the current period.

II 1.4.2.3 CARCASS WEIGHT

The carcass weight function for beef (CWBF) is a national average for all beef categories. The average weights are affected by cattle prices (PSS) and grain prices (OPBA), both lagged two quarters. The hog carcass weight relationship (CWHG) is similar, lagged 1 on price, 3 on grain price and available on a regional basis. In the case of beef it should be recognized that a large component of the variability in carcass weights is due to changing mixes of categories of animals in the total slaughter.

II 1.4.2.4 INTER-REGIONAL PRICE TRANSMISSION

The trade relationships between regions are specified as regional price linkage equations. For example, net trade in beef between Western Canada and the United States (NT1BF4) depends on the wholesale price of both region, the United States–Canadian exchange rate (ER34), and a lagged endogenous variable. The equations are similar for heifers, cows and steers trade. The lagged dependent variable is used to reflect the idea that trade do not adjust immediately and that there are costs associated with increased inter-regional trade.

II 1.4.2.5 VERTICAL PRICE TRANSMISSION

The wholesale-to-retail price linkages for beef and pork are specified with the retail price related to the wholesale price, stock, wages, price of blended crude oil (PB0IL3) and exchange rate.

The farm-to-wholesale beef price linkage is expressed in first differences (to the exception of cow prices) and includes the value of by-products, slaughters and wages. Individual equations are estimated for steers, heifers and cows and related to wholesale steer carcass prices.

The steer-to-feeder calf price transmission is a partial representation of the determination of feeder calf prices since trade between Canada and the United States in feeder calves and cattle is ignored. The feeder calf price (PFC) is determined by the previous quarters slaughter steer price and grain price and a lagged dependent variable. The relationship reflects the fact that the major cost for feedlot operators is feed.

II 1.4.2.6 COLD STORAGE MEAT STOCKS

The closing demand for cold storage stocks of beef (IBF) is expressed as a function of the current wholesale steer carcass price, beef production, and a lagged dependent variable.

In pork only production and a lagged dependent variable were used.

II 1.5 Data

II 1.5.1 Data sources

The livestock component relies primarily on the following sources of data: Agriculture Canada, *Livestock and Meat Trade Report* and *Livestock Market Review*; Statistics Canada, *Report on Livestock Surveys, Cattle, Sheep, Horses* (catalogue no. 23-004), and *Stocks of Frozen Meat Products* (catalogue no. 32-012); and the United States Department of Agriculture, *Livestock and Meat Situation* and *Livestock and Meat Statistics*.

Data on Canada's trade in beef and pork were obtained from Trade of Canada unpublished data tapes, and compiled by Statistics Canada. These tapes contain monthly data on Canada's trade by province, by commodity class, and by country of origin-destination.

Estimates of trade in the three categories of beef animals (steers, heifers and cows) were derived from identities using data on marketings and federal inspected slaughter.

Data used were generally from 1970Q1 to 1980Q4 and were quarterly, except for the inventories (noted below). (For a complete listing of data see Appendix IIB.

II 1.5.2 Data problems

The matching of data and economic concepts is often difficult and the resultant compromises are frequently unsatisfactory. A number of such areas of difficulty for the beef and pork components will be briefly discussed.

The calculation of the regional disappearance of beef and pork is impossible because time series are not available on inter-provincial flows of meat. For this reason a single consumption function is used for the whole of Canada. Another difficulty is matching the retail disappearance data reported by Statistics Canada with the inspected slaughter data. The latter is published quarterly, by province and commonly used by the industry. The difference is largely due to uninspected slaughter and slaughter on farms data. Since the uninspected slaughter data are not available when we enter in forecast mode, we had to built our own per capita disappearance based on inspected slaughter only.[13]

Trade data also posed difficulties. For example, trade by sex is not recorded and this required the derivation of net trade flows using the difference between federally inspected slaughter and marketings data for each sex category.

Beef and pork trade between Western and Eastern Canada and the United States were obtained from special tabulations of Statistics Canada data which give country of origin or destination by province of lading or entry. The various categories were converted to chilled carcass weight equivalents in the case of beef and chilled trimmed dressed weight in the case of pork.

Farm inventories of cattle suffer from a number of difficulties. First, since the data are only provided semi-annually, interpolation was required to obtain quarterly data. Second, the data suffer a number of definitional problems such as the distinction between beef and dairy cows, bias from non-respondents between census years, and a change in definition for heifers.

A number of other difficulties are involved with the choice of representative prices, the use of average carcass weight data for all cattle rather than the various sex categories, and data on cold storage stocks which omits fresh and some processed meats.

II 1.6 Emphirical results

II 1.6.1 Representative results

The beef and pork components were estimated using ordinary least squares and quarterly data generally over the period 1970 Q1 to 1980 Q4. A complete set of estimated coefficients and associated statistics for all equations in the livestock component is given in Appendix IIC. Results for selected equations are presented in Table 1.6.2.1 for beef and Table 1.6.2.2 for pork. Beef results are reported for Western Canada and pork results for Eastern Canada. Brief comments are made on similar equations for other regions, product categories and types of relationship.

In those Tables 1.6.2.1 and 1.6.2.2, estimated coefficients, with their standard errors in parentheses below and coefficients of determination (R^2) are given.

II 1.6.2 BEEF CATTLE INVENTORIES

The estimated coefficients for the equation for beef cow inventories in Western Canada is show in equation (1), Table 1.6.2.1. The explanatory power is excellent ($R^2 = 0.99$) and most variables are significant and with correct signs. Beef cow inventories are negatively related to cow marketings, lagged heifer prices, interest rate, heifer to steer marketing ratio and cow marketings but are stimulated by higher lagged calf prices. Results for the east are similar to those in the west.

Steer inventoires equations have good explanatory power ($R^2 = 0.94$), and in Western Canada have

TABLE II 1.6.2.1. ESTIMATED COEFFICIENTS FOR SELECTED EQUATIONS IN THE BEEF COMPONENT

(1) Inventory demand for beef cows and bulls, Western Canada (thousand head)

IBW1 = 115.2 + 123.42*JS1 + 100.22*JS2 − 14.85*JS3 − .82*SBW1 + 1.76*PFC1(−3)
(32.4) (12.7) (14.4) (12.91) (0.17) (0.7)
− 5.77*RFC3(−3) + 1.02*IBW(−1) − 173.55*(SHF1(−6)/SSS1(−6) − 1.89*PHF1(−3)
(2.74) (0.01) (33.86) (1.18)
$R^2 = 0.99$ DW = 1.68 SER = 32.32

(2) Steer marketings, Western Canada (thousand head)

SSS1 = 0.042*JS1*IBW1(−8) + 0.025*JS2*IBW1(−8) − 0.044*JS3*IBW1(−8)
(0.01) (0.012) (0.013)
+ 0.006*JS4*IBW1(−8) + 0.65*SSS1(−1) − 42.25*JS1 + 13.69*JS2 + 239.42*JS3 + 52.79*JS4
(0.011) (0.144) (49.65) (37.57) (36.31) (53.98)
$R^2 = 0.68$ DW = 2.16 SER = 15.97

(3) Average carcass weight for all cattle slaughtered, Canada, (pounds per head)

CWBF3 = 348 + 8.9*JS1 + 4.47*JS2 + 1.08*JS3 + 0.83*PSS1(−2) − 0.29*OPBA3(−2)
(66.86)(3.07) (3.25) (3.17) (0.17) (0.06)
+ 0.35*CWBF3(−1)
(0.12)
$R^2 = 0.86$ DW = 1.80 SER = 7.14

(4) Cold storage stocks demand for beef, Western Canada (million pounds)

IBF1 = −3.69 + 0.11*JS1 − 1.88*JS2 − 2.83*JS3 − 0.008*WPSS1 + 0.04*QBF1
(2.11) (0.74) (.84) (0.74) (0.0088) (0.009)
+ 0.49*IBF1(−1)
(0.103)
$R^2 = 0.81$ DW = 1.71 SER = 1.67

(5) Wholesale steer-to-retail beef price transmission, Canada (1971 = 100)

RPBF3 = −118.94 − 0.03*(IBF1(−1) + IBF2(−1)) + 1.132*((WPSS1 + WPSS2)/2)
(15.01) (0.05) (0.097)
+ 0.06*(0.2*WA3 + PBO1L3) + 107.90*ER34 + 0.422*RPBF3(−1)
(0.115) (16.24) (0.047)
$R^2 = 0.996$ DW = 1.93 SER = 4.13

correct signs and are significant. In the east, however, few coefficients are significant, indicating some statistical problems. Inventories of heifers also have good explanatory power ($R^2 = 0.94$). In both regions, heifer marketings and lagged inventory coefficients were significant. Most other variables were not found to be significant.

II 1.6.2.1 BEEF CATTLE MARKETINGS

The estimated coefficients for the equation for marketings of steers in Western Canada are shown in equation (2). The estimation of short term marketings are relatively good ($R^2 = 0.68$), with most signs of coefficients as expected. Not all coefficients were significant, however. Steer marketings in the east has slightly higher coefficients of determination (R^2) and lagged grain and steer prices have expected signs.

In general, heifer marketing equations in the two regions had higher R^2, but few coefficients were significant.

Cow marketing equations in general had good explanatory power (R^2 of .76 to .82) and most variables had correct signs and significance (especially Western Canada).

II 1.6.2.2 BEEF CARCASS WEIGHT

The estimated coefficients for average carcass weights for beef cattle in Canada, are shown in equation (3). Estimated coefficients have correct signs and are significant. Higher steer prices increase while high grain prices decrease carcass weights.

II 1.6.2.3 COLD STORAGE STOCKS DEMAND FOR BEEF

Equation (4) presents the estimated coefficients for cold storage stocks demand for beef in Western Canada. Explanatory power is good ($R^2 = 0.81$) and all coefficients have the correct sign. Stocks are lowest in the second and third quarters. Lower stocks occur when the wholesale price goes up and the production falls. Larger beef stocks are held in the east and that equation had lower explanatory power ($R^2 = 0.62$). Most variables were significant.

TABLE II 1.6.2.2. ESTIMATED COEFFICIENTS FOR SELECTED EQUATIONS IN THE PORK COMPONENT

(1) Demand for closing stocks of pork, Eastern Canada (million pounds)

$$\begin{aligned} IPK2 = {} & 4.18 + 1.55*JS1 - 0.85*JS2 - 3.09*JS3 + 0.027*QPK2 + 14.01*D19712 + 0.45*IPK2(-1) \\ & (1.49)\ (0.84)\ (0.92)\ (0.93)\ (0.007)\ (2.12)\ (0.089) \\ & R^2 = 0.82 \quad DW = 2.03 \quad SER = 1.97 \end{aligned}$$

(2) Average hog carcass weight, Eastern Canada (pounds per head)

$$\begin{aligned} CWHG2 = {} & 9.57 - 0.256*JS1 - 1.75*JS2 - 1.59*JS3 + 0.012*PHG2(-1) - 0.003*FPCO2(-3) \\ & (8.44)\ (0.42)\ (0.43)\ (0.42)\ (0.013)\ (0.007) \\ & + 0.93*CWHG2(-1) \\ & (0.065) \\ & R^2 = 0.88 \quad DW = 2.09 \quad SER = 0.965 \end{aligned}$$

(3) Inventory of hogs, Eastern Canada (thousand head)

$$\begin{aligned} IHG2 = {} & 3730.4 - 58.06*JS1 - 61.27*JS2 - 3.103*JS3 - 3.99*FPCO2(-2) + 8.52*PHG2(-2) \\ & (100.46)\ (59.83)\ (61.42)\ (59.72)\ (1.5)\ (1.91) \\ & - 7.09*RFC3(-2) + 2.89*DQUE \\ & (16.11)\ (0.08) \\ & R^2 = 0.99 \quad DW = 0.49 \quad SER = 138.84 \end{aligned}$$

(4) Marketings of Hogs, Eastern Canada (thousand head)

$$\begin{aligned} SHG2 = {} & 49.53 - 25.27*JS1 - 79.17*JS2 - 118.20*JS3 + 0.189*IGH2(-1) + 0.465*SHG2(-1) \\ & (31.75)\ (20.3)\ (21.2)\ (19.67)\ (0.026)\ (0.082) \\ & R^2 = 0.99 \quad DW = 2.02 \quad SER = 43.50 \end{aligned}$$

(5) Hog price to retail pork price transmission, Canada (1971 = 100)

$$\begin{aligned} RPPK3 = {} & 46.8 - 0.06*JS1*PHG2 - 0.094*JS2*PHG2 + 0.01*JS3*PHG2 + 1.25*PHG2 \\ & (11.13)\ (0.021)\ (0.023)\ (0.023)\ (0.064) \\ & + 55.69*ER34 - 0.058*(IPK1(-1) + IPK2(-1)) + 0.665*(WA3*.2 + PBOIL3) \\ & (10.89)\ (0.069)\ (0.085) \\ & R^2 = 0.998 \quad DW = 1.83 \quad SER = 2.76 \end{aligned}$$

II 1.6.2.4 VERTICAL PRICE TRANSMISSIONS FOR BEEF

The estimated coefficients for the wholesale-to-retail price transmissions are shown in equation (5). The explanatory power is very high (R^2 = 0.99). The price coefficients, wholesale and lagged retail are positive and highly significant. The coefficients for wages, price of oil, exchange rate and lagged stocks have all the good signs.

For the farm-to-wholesale price transmissions, for steers in both regions, explanatory power is good (R^2 = 0.94 to 0.98) but only wholesale prices and value of by-product are significant. The eastern equation is similar, except that wages and slaughter demand were also significant.

For heifers, most variables were significant with the correct sign. Wages was the exception in the west.

II 1.6.2.5 PORK STOCKS

The estimated coefficients for demand for closing cold storage stocks of pork in Eastern Canada is shown in equation (1), Table II 1.6.2.2. Explanatory power is good (R^2 = 0.82) and most coefficients are significant.

Stocks are higher when production increases. Similar results were obtained in Western Canada.

II 1.6.2.6 HOG CARCASS WEIGHTS

Equation (2) contains estimated coefficients for the average carcass weights for hogs in Eastern Canada. Model results are satisfactory reflecting that these weights have varied only marginally during this period. The main significant variable is lagged carcass weights. This reflects the incentives built into the grading system in Canada to market hogs at a particular weight.

II 1.6.2.7 HOG INVENTORIES

The estimated coefficients for inventory of hogs in Eastern Canada are shown in euqation (3). The degree of fit is good (R^2 of .99) all signs conform to prior expectations and most of the coefficients are statistically significant. Inventories are positively related to lagged hog prices and negatively relatived to feed prices and interest rates. The dummy variable DQUE was included to take account of the vertical integration practices and governmental aid in the province of Quebec in the period 1977 to 1981. Similar results were obtained in the West.

II 1.6.2.8 HOG MARKETINGS

The estimated coefficients for marketings of hogs in Eastern Canada are shown in equation (4). Results are good with an R^2 of 0.99 and most coefficients significant. Marketings are highest in the fourth quarter and are a simple function of opening inventory. The coefficient on lagged supplies is large indicating a slow adjustment. Again similar results in the west were obtained.

II 1.6.2.9 VERTICAL PRICE TRANSMISSIONS FOR PORK

Equation (5) contains the estimated coefficients for the wholesale to retail price transmission equation for pork in Canada. Explanatory power is high, all coefficients have the correct sign, and most are significant.

Higher retail prices occur when wholesale prices increase, stocks are low, wages and price of oil increase and the value of the Canadian dollar depreciates.

II 1.7 Validation of livestock component

There are a number of performance tests to which econometric models can be subjected. In the previous sections, individual equations were analyzed as to their statistical and economic properties (R^2, t-test, etc.). There is no guarantee, however, that satisfactory performance in those tests will ensure that endogenous variables perform well as part of a total model. Two initial tests performed on this provisional model were within sample (or *ex post* simulation) and extra sample (or *ex post* forecasting). The *ex post* simulation procedure was to simulate the beef and pork components separately over the estimation period 1970 Q1 to 1980 Q4. The simulation used the actual exogenous variables while the model determined the endogenous variables, letting any errors be transmitted from period to period. The *ex post* forecast was a simulation of the model over a range outside the estimation period (1981 Q1 to 1981 Q4), again using actual exogenous variables and the initial values of the lagged endogenous variables.

To present a measure of the simulation performance the root mean square (RMS) percentage error was used. This is a measure of the deviation of simulated values from the historical series. This value is presented for each of the endogenous variables in the model in Tables II 1.7.1.1 and 1.7.1.2.

TABLE II 1.7.1.1. VALIDATION RESULTS FOR THE BEEF COMPONENT

Endogenous Variable	Historical Period 1970 Q1 to 1980 Q4		Forecast Period 1981 Q1 to 1981 Q4	
	Mean Percentage Error	Root Mean Squared Percentage Error	Mean Percentage Error	Root Mean Squared Percentage Error
Average carcass weight of cattle				
CWBF3	−0.01	1.32	−1.54	1.58
Demand for beef				
DBF1	0.24	4.14	6.17	8.37
DBF2	0.24	4.14	6.17	8.37
DBF3	0.24	4.14	6.17	8.37
Cow and bull slaughter demand				
DBW1	−0.81	16.66	0.37	7.86
DBW2	−1.8	18.03	1.33	4.35
DBW3	−1.76	15.69	0.61	4.94
Heifer slaughter demand				
DHF1	3.38	14.20	15.27	19.70
DHF2	5.28	13.86	15.33	16.02
DHF3	3.82	11.58	15.15	17.68
Steer slaughter demand				
DSS1	−0.67	7.93	5.35	5.65
DSS2	2.7	9.61	11.35	14.17
DSS3	0.52	6.47	7.82	9.02
Closing stocks of beef				
IBF1	1.07	15.67	53.08	65.31
IBF2	5.64	20.83	69.59	82.56
IBF3	4.27	17.62	66.80	79.30
Closing inventory of cows and bulls				
IBW1	−2.49	2.98	−2.33	2.36
IBW2	−0.75	3.39	−2.81	3.30
IBW3	−2.16	2.75	−2.43	2.49
Closing inventory of heifers				
IHF1	0.41	4.87	5.37	5.73
IHF2	0.93	4.91	2.60	2.95
IHF3	0.49	3.86	4.41	4.60
Closing inventory of steers				
ISS1	−1.85	4.56	4.55	4.97
ISS2	−0.37	3.27	− 3.72	6.21
ISS3	−1.22	3.25	0.82	1.43
Net trade in cows and bulls				
NTBW1	−1.7 [a]	11.13[a]	2.62[a]	3.79[a]
NTBW2	0.54[a]	8.86[a]	− 0.22[a]	1.10[a]
NTBW3	−1.17[a]	17.52[a]	2.40[a]	2.96[a]
Net trade in heifers				
NTHF1	−3.03[a]	11.68[a]	− 9.16[a]	10.42[a]
NTHF2	−1.85[a]	6.15[a]	− 1.14[a]	2.84[a]
NTHF3	−4.88[a]	11.94[a]	−10.31[a]	12.18[a]
Net trade in steers				
NTSS1	0.11[a]	10.31[a]	− 5.47[a]	7.04[a]
NTSS2	−2.32[a]	15.77[a]	14.57[a]	20.35[a]
NTSS3	−2.21[a]	21.17[a]	9.10[a]	19.45[a]

(continued)

TABLE II 1.7.1.1. VALIDATION RESULTS FOR THE BEEF COMPONENT (Concluded)

Endogenous Variable	Historical Period 1970 Q1 to 1980 Q4		Forecast Period 1981 Q1 to 1981 Q4	
	Mean Percentage Error	Root Mean Squared Percentage Error	Mean Percentage Error	Root Mean Squared Percentage Error
Net trade in beef				
NT1BF2	−1.08[a]	11.84[a]	7.59[a]	8.91[a]
NT1BF4	0.02[a]	2.59[a]	− 2.03[a]	2.17[a]
NT2BF4	0.23[a]	6.23[a]	− 8.64[a]	11.17[a]
NT3BF4	0.25[a]	7.94[a]	−10.66[a]	12.72[a]
Price of slaughter cows				
PBW1	3.67	10.35	1.49	5.19
PBW2	0.83	20.45	2.71	4.14
Per capita demand for beef				
PCDBF3	0.24	4.14	6.18	8.37
Price of feeder calves				
PFC1	6.8	16.73	13.91	15.81
PFC2	6.17	14.28	7.21	9.81
Price of slaughter heifers				
PHF1	7.27	11.48	6.93	8.07
PHF2	6.71	10.59	4.01	4.95
Price of slaughter steers				
PSS1	0.66	8.23	4.36	5.63
PSS2	3.13	8.01	4.47	5.69
Production of beef				
QBF1	−0.01	5.85	5.75	7.50
QBF2	1.23	7.35	8.15	9.54
QBF3	0.35	4.56	6.74	8.16
Retail prices for beef				
RPBF3	0.51	5.86	4.81	5.38
Cow and bull marketings				
SBW1	−1.17	18.71	2.95	9.89
SBW2	−0.24	14.33	0.97	3.18
SBW3	−1.28	14.55	1.91	5.84
Heifer marketings				
SHF1	2.23	15.8	8.63	12.78
SHF2	2.1	10.68	14.4	14.57
SHF3	1.63	11.6	10.33	12.16
Steer marketings				
SSS1	−0.55	7.68	2.88	3.24
SSS2	1.93	11.09	23.7	24.09
SSS3	0.00	7.05	10.71	10.97
Wholesale price of steer carcasses				
WPSS1	0.68	8.59	4.66	6.06
WPSS2	0.37	6.78	6.53	7.33

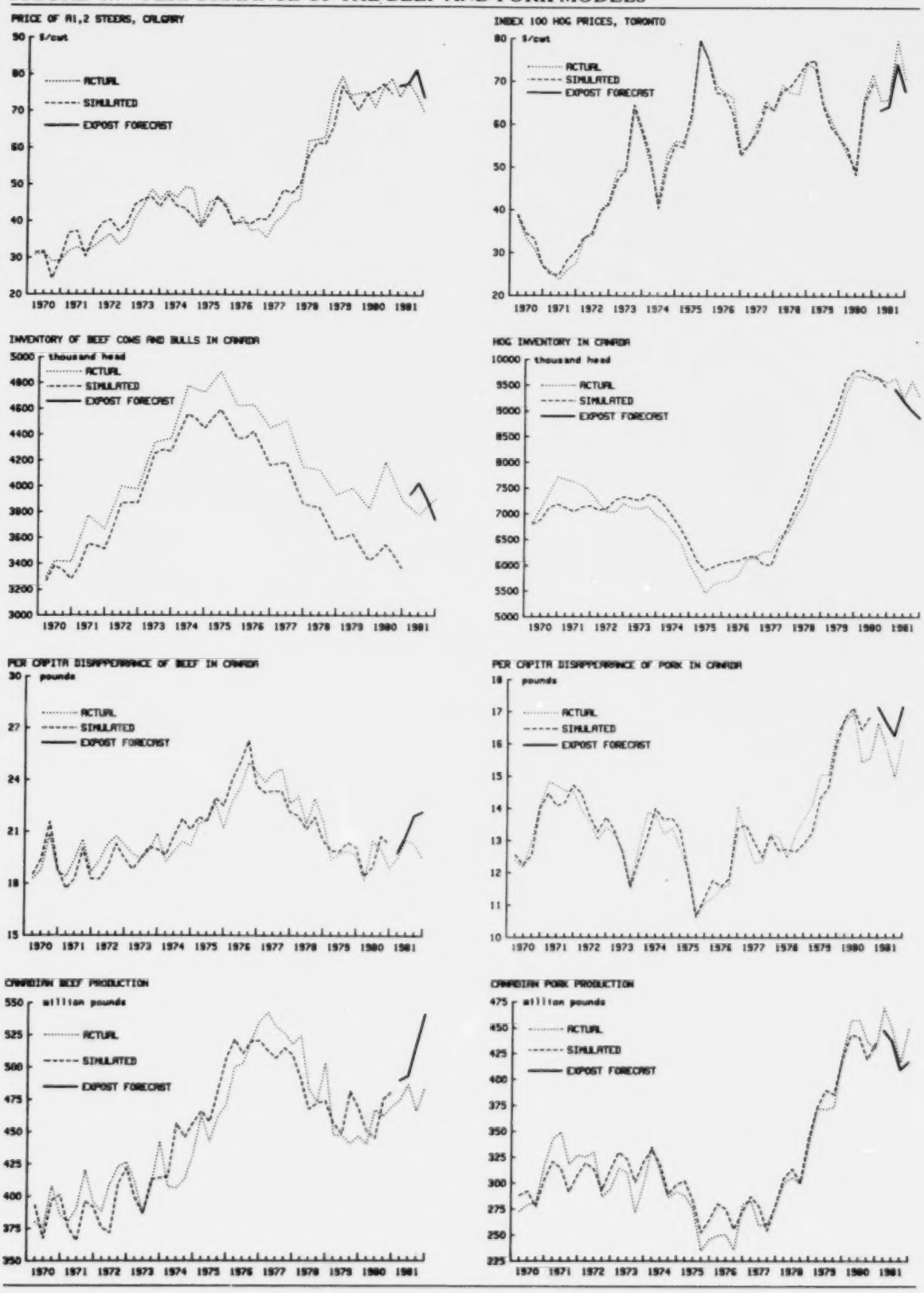
[a] Denotes mean error and root mean square error rather than percentages.

TABLE II 1.7.1.2. VALIDATION RESULTS FOR THE PORK COMPONENT

Endogenous Variable	Historical Period 1970 Q1 to 1980 Q4		Forecast Period 1981 Q1 to 1981 Q4	
	Mean Percentage Error	Root Mean Squared Percentage Error	Mean Percentage Error	Root Mean Squared Percentage Error
Carcass weights				
CWHG1	0.006	0.88	− 1.77	1.20
CWHG2	0.388	1.32	− 0.30	0.49
CWHG3	0.87	1.73	− 0.52	0.61
Hog slaughter				
DHG1	4.21	9.56	−12.82	14.00
DHG2	0.07	3.93	0.17	2.19
DHG3	1.30	4.90	− 3.51	4.02
Hog inventory				
IHG1	3.73	8.78	−15.26	16.19
IGH2	0.1	3.17	2.28	3.01
IHG3	1.17	4.10	− 3.18	3.8
Pork Demand				
DPK1	0.07	3.31	4.15	4.38
DPK2	0.07	3.31	4.15	4.38
DPK3	0.07	3.31	4.15	4.38
Cold storage stocks of pork				
IPK1	12.41	38.28	29.42	33.00
IPK2	2.28	13.36	9.01	20.00
IPK3	3.72	17.17	13.48	17.25
Net trade in pork				
NT1PK2	1.45[a]	6.81[a]	−13.01[a]	13.99[a]
NT1PK4	1.73[a]	6.89[a]	− 9.12[a]	11.95[a]
NT2PK4	1.57[a]	13.75[a]	−26.11[a]	26.31[a]
NT3PK4	3.3 [a]	18.21[a]	−35.23[a]	36.01[a]
Per capita pork disappearance				
PCDPK3	0.07	3.31	4.15	4.38
Price of hogs				
PHG1	0.07	3.01	1.33	2.87
PHG2	0.22	3.45	− 1.07	3.26
Supply of pork				
QPK1	4.22	9.60	−13.85	14.91
QPK2	0.46	4.13	− 0.13	2.41
QPK3	1.55	5.26	− 3.99	4.57
Retail pork price				
RPPK3	0.11	1.85	0.83	2.34
Hog marketings				
SHG1	4.15	9.44	−12.56	13.72
SHG2	0.07	3.91	0.17	2.19
SHG3	1.29	4.87	− 3.48	3.99

[a] Denotes mean error and root mean squared error rather than percentages.

FIGURE 1.7 PERFORMANCE OF THE BEEF AND PORK MODELS



The RMS percentage error has a large upward bias, as values in any series tend toward zero. This is the case with the net trade data. Percentage errors appear large, while in absolute terms the error may be quite small. Graphs of four beef and pork variables are illustrated in Figure II 1.7, showing both simulated and forecast results.

II 1.7.1 Ex post simulation results

There are a few variables in the beef model with large errors. However, nearly one-half of the variables had RMS percentage error of ten or less. The net trade functions in particular, because of the bias noted above performed poorly. As well, the errors on prices tended to be larger than those of the quantities variables.

The simulation results for the pork model are generally better than for the beef model. Most variables had RMS percentage error of ten percent or less, except for pork stocks and net trade variables.

Figure II 1.7 illustrate how well the model performed over the simulation period. Beef prices in the west were underestimated during their rise in 1973–1974 and subsequently over-predicted during 1975–1976–1977. For beef production, there were large underestimates in 1972–1973 and in 1976–1977. There is also a strong over prediction in 1981 due to per capita disappearance. Bull and cow inventories were underestimated throughout the period. Per capita disappearance was reasonably good except over the recent period.

Hog prices in Toronto were predicted well, with the model missing part of the large decline in 1970–1971. Pork production and hog inventory were also quite well predicted. Per capita disappearance was reasonably good except over the period 1978 to 1981.

II 1.7.2 Ex post forecast

The RMS percentage error for the ex post forecasts for the 1981 Q1 to 1981 Q4 are also included in Tables II 1.7.1.1 (for beef) and 1.7.1.2 (for pork). These were generally higher for the ex post forecast period than those obtained for the estimation period.

The last four observations in Figure II 1.7 show the results of the ex post forecast for 1981. Western beef price, per capita disappearance and production were forecast too high but cow inventories reasonably well. Hog price predictions were very good while production and inventory were under forecast in the latter part of the year. Per capita disappearance was over forecast throughout 1981.

II 1.8 Assessment of livestock component

II 1.8.1 Application of the model

The model was primarily constructed as a forecasting tool designed to provide short-to-medium term forecasts. Because of the long biological lags in beef production and to a lesser extent in pork production, medium term forecasts can probably be developed with low endogenously determined forecast errors.

The initial performance tests suggest that the model can provide reasonably reliable forecasts. Nevertheless, considerably more testing of the model is required to improve the forecasts.

The model can also be adapted to evaluate a number of policy questions relating to the beef and pork sectors. These would include trade policy (tariffs, quotas), transportation rates, and stabilization policies. As well, the effects on the livestock sector of policy changes in other sectors of the economy and changes in market regulations such as livestock grading, or health restrictions may be analyzed.

II 1.8.2 Future work

The model as presented in this bulletin is a provisional structure. A number of revisions are anticipated during the next few months, particularly for those equations with questionable structural characteristics and poor historical or forecasting performance. The per capita disappearance of both beef and pork would appear to be an area for such changes.

In terms of extensions to the model, development of a veal component is currently in process.

II 1.9 Notes and bibliography

II 1.9.1 Notes

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3. Statistics Canada, *Trade of Canada*, 1978, External Trade Division
4. Agriculture Canada, *Canada Livestock and Meat Trade Report* (Monthly); Beef Consumption estimated by Agriculture Canada. For methodology see Statistics Canada, *Estimates of Production and Disappearance of Meats*, 1977, Cat. No. 32-270

5. Statistics Canada, *Urban Family Food Expenditure*, Cat. No. 62-548
6. Statistics Canada, *Quarterly Hog Survey*
7. Statistics Canada, *Farm Net Income*
8. Statistics Canada, *Trade of Canada*, 1978, External Trade Division
9. Agriculture Canada, *Canada Livestock and Meat Trade Report* (Monthly)
10. Pork Consumption estimate by Agriculture Canada; for methodology see Statistics Canada, *Estimates of Production and Disappearance of Meats*, 1977, Cat. No. 32-270
11. Statistics Canada, *Urban Family Food Expenditure*, Cat. No. 62-548
12. Including current beef prices apparently caused a problem of dynamic instability and therefore were omitted
13. (Inspected production + opening stock − ending stock − net trade) Population = per capita disappearance

II 1.9.2 Bibliography

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APPENDIX IIA: TRADE AND STABILIZATION POLICY CHANGES IN THE LIVESTOCK INDUSTRY, 1973–1976

1. Trade policies

During the 1965–1972 period under study, the livestock industries of Canada and the United States operated harmoniously. Tariffs were modest and product flowed freely between countries. However, on February 19, 1973, the federal budget eliminated tariffs on live cattle and beef as an anti-inflationary measure. These were restored on September 21, 1973 in advance of schedule.

In 1973, the United States introduced price ceilings on meats (April 1) which were removed on pork on July 18 but remained until September 9 for beef. As imported meat was exempt and to prevent further price escalation on the Canadian market, export controls were introduced by Canada for A and B grade beef from August 13 to September 14, 1973. United States cattle withheld from the market during price controls were subsequently marketed. Again, to protect the Canadian market against an extremely large volume of imports, a 200 percent tariff surtax was introduced in November, 1973. The surtax was gradually eliminated during January and ended on February 14, 1974.

The use of the growth hormone DES (diethylstiberteral) was banned in Canada and the United States. However, a United States Court of Appeals countermanded an earlier U.S. Food and Drug Administration decision. On April 9, 1974, Canada required a certificate stating no DES had been administered on imported U.S. cattle and beef. The procedure for certification was agreed with the United States on August 2, 1974.

On August 2, 1974, Canada introduced import controls on live cattle (82,835 head) and beef (125.8 million pounds), based on a five year average (1969–1973) and allocated up to 30 percent on a quarterly basis. The controls were introduced to prevent disruption of a new beef stabilization program. The United States responded on November 16, 1974, with very restrictive quotas on live cattle (17,000 head), live hogs (50,000 head), beef (17 million pounds), and pork (36 million pounds), for the period August 12, 1974 to August 11, 1975. Canada removed the quotas on Canadian live cattle, hogs and pork on August 7, 1975. Canada established import quotas for dressed beef imports from all countries for August 12 to December 31, 1975 of 48.6 million pounds (41.6 million pounds from Oceania and 7.0 million pounds frcm the United States). Quotas on beef and veal were terminated on December 31 by both Canada and the United States.

On October 9, 1976, United States allocated Canada, U.K., Ireland and Belize a 1976 quota of 86 million pounds as a share of its total import under its Meat Import Law. This was in response to rapid interntional meat price declines and increasingly restrictive foreign markets.

On October 18, 1976, Canada announced quotas on beef imports for the period October 17 to December 31, 1976, of 17.5 million pounds (Oceania 13.0 million pounds and the United States 4.5 million pounds).

2. Stabilization programs for livestock

Beef and pork were named commodities in a stabilization program which was in existence under the 1958 Agricultural Stabilization Act during the 1965–73 period. Trigger prices were based on an 80 percent of a 10 year average price and were so low, that no payments were made.

A new stabilization program for hogs was introduced on May 22, 1974, for the April 1, 1974 to March 31, 1975 period. A deficiency payment would be paid based on a guarantee of the margin between hog prices and feed costs. No payments were made under this program or for a similar program continued in 1975–1976.

For beef, Canada announced a beef quality premium with a direct payment of 7 cents per pound for A grade cattle in March, 1974. This was amended on April 1 to 5 cents per pound for all steers and heifers and then reduced on April 27 to 3 cents per pound. It was phased out a 1 cent per pound during three weeks in August, 1974. On August 12, 1974, it was replaced by a new beef stabilization program. Under this new program, a deficiency payment would be made for A1-2 cattle on August 11, 1975, if the market price fell

below a nationally weighted annual average price of $45.42 per cwt. The support price was based on 90 percent of the previous year average (1969–1973) indexed by input costs. A payment of 48 cents per cwt. was announced September 22, 1975. The program was extended to December 31, 1975 at a support price of $43.94 per cwt.

In December 1974, Canada initiated a cow-beef stabilization program with a deficiency payment for cows for the period November 16, 1974 to April 30, 1975. Prices were supported at 100 percent of a five year average ($23.21 per cwt.). This resulted in a payment of $5.08 per cwt., announced on May 9, 1975. As well, supermarket promotions for ground beef and a foreign aid program for canned beef were initiated.

An amended Agricultural Stabilization Act was introduced in July 1975, which included slaughter cattle and hogs as named commodities. Minimum support level was 90 percent of the previous five year average indexed by current versus average cash costs of the previous five years. As a result, payments were made to hog producers in the fiscal years 1979–1980 ($2.23/cwt.) and 1980–1981 ($5.35/cwt.). Similar stabilization payment were implemented by some of the provinces.

APPENDIX 11B: LIST OF VARIABLES AND EQUATIONS

MODEL: BEEF

SYMBOL DECLARATIONS

ENDOGENOUS:

CWBF3	- AVERAGE CATTLE CARCASS WEIGHT, CANADA (LB/HD)
DBF1	- DISAPPEARANCE OF BEEF (USING FED. INSP. SLAU.), WESTERN CANADA (MIL. LB)
DBF2	- DISAPPEARANCE OF BEEF (USING FED. INSP. SLAU.), EASTERN CANADA (MIL. LB)
DBF3	- DISAPPEARANCE OF BEEF (USING FED. INSP. SLAU.), CANADA (MIL. LB)
DBW1	- FEDERALLY INSPECTED SLAUGHTER OF COWS AND BULLS, WESTERN CANADA ('000)
DBW2	- FEDERALLY INSPECTED SLAUGHTER OF COWS AND BULLS, EASTERN CANADA ('000)
DBW3	- FEDERALLY INSPECTED SLAUGHTER OF COWS AND BULLS, CANADA ('000)
DHF1	- FEDERALLY INSPECTED SLAUGHTER OF HEIFERS, WESTERN CANADA ('000)
DHF2	- FEDERALLY INSPECTED SLAUGHTER OF HEIFERS, EASTERN CANADA ('000)
DHF3	- FEDERALLY INSPECTED SLAUGHTER OF HEIFERS, CANADA ('000)
DSS1	- FEDERALLY INSPECTED SLAUGHTER OF STEERS, WESTERN CANADA ('000)
DSS2	- FEDERALLY INSPECTED SLAUGHTER OF STEERS, EASTERN CANADA ('000)
DSS3	- FEDERALLY INSPECTED SLAUGHTER OF STEERS, CANADA ('000)
IBF1	- CLOSING STOCKS OF BEEF, WESTERN CANADA (MIL. LB)
IBF2	- CLOSING STOCKS OF BEEF, EASTERN CANADA (MIL. LB)
IBF3	- CLOSING STOCKS OF BEEF, CANADA (MIL. LB)
IBW1	- CLOSING INVENTORY OF COWS AND BULLS, WESTERN CANADA ('000)
IBW2	- CLOSING INVENTORY OF COWS AND BULLS, EASTERN CANADA ('000)
IBW3	- CLOSING INVENTORY OF COWS AND BULLS, CANADA ('000)
IHF1	- CLOSING INVENTORY OF HEIFERS, WESTERN CANADA ('000)
IHF2	- CLOSING INVENTORY OF HEIFERS, EASTERN CANADA ('000)
IHF3	- CLOSING INVENTORY OF HEIFERS, CANADA ('000)
ISS1	- CLOSING INVENTORY OF STEERS, WESTERN CANADA ('000)
ISS2	- CLOSING INVENTORY OF STEERS, EASTERN CANADA ('000)
ISS3	- CLOSING INVENTORY OF STEERS, CANADA ('000)
NTBW1	- NET TRADE IN COWS AND BULLS (USING FED. INSP. SLAU.), WESTERN CANADA ('000)
NTBW2	- NET TRADE IN COWS AND BULLS (USING FED. INSP. SLAU.), EASTERN CANADA ('000)
NTBW3	- NET TRADE IN COWS AND BULLS (USING FED. INSP. SLAU.), CANADA ('000)
NTHF1	- NET TRADE IN HEIFERS (USING FED. INSP. SLAU.), WESTERN CANADA ('000)
NTHF2	- NET TRADE IN HEIFERS (USING FED. INSP.SLAU.), EASTERN CANADA ('000)
NTHF3	- NET TRADE IN HEIFERS (USING FED. INSP. SLAU.), CANADA ('000)
NTSS1	- NET TRADE IN STEERS (USING FED. INSP. SLAU.), WESTERN CANADA ('000)
NTSS2	- NET TRADE IN STEERS (USING FED. INSP. SLAU.), EASTERN CANADA ('000)
NTSS3	- NET TRADE IN STEERS (USING FED. INSP. SLAU.), CANADA ('000)
NT1BF2	- NET TRADE IN BEEF (USING FED. INSP. SLAU.), WESTERN TO EASTERN CANADA (MIL. LB)
NT1BF4	- NET TRADE IN BEEF, WESTERN CANADA TO THE U.S.A. (MIL. LB)
NT2BF4	- NET TRADE IN BEEF, EASTERN CANADA TO THE U.S.A. (MIL. LB)
NT3BF4	- NET TRADE IN BEEF, CANADA TO THE U.S.A. (MIL. LB)
PBW1	- PRICE OF SLAUGHTER COWS (D1,2), CALGARY ($/CWT)
PBW2	- PRICE OF SLAUGHTER COWS (D1,2), TORONTO ($/CWT)
PCDBF3	- PER CAPITA DISAPPEARANCE OF BEEF (USING FED. INSP. SLAU.), CANADA (LB)
PFC1	- PRICE OF FEEDER CALVES (400-600 LB), CALGARY ($/CWT)

PFC2 - PRICE OF FEEDER CALVES (400-600 LB), TORONTO ($/CWT)
PHF1 - PRICE OF SLAUGHTER HEIFERS (A1,2), CALGARY ($/CWT)
PHF2 - PRICE OF SLAUGHTER HEIFERS (A1,2), TORONTO ($/CWT)
PSS1 - PRICE OF SLAUGHTER STEERS (A1,2), CALGARY ($/CWT)
PSS2 - PRICE OF SLAUGHTER STEERS (A1,2), TORONTO ($/CWT)
QBF1 - FEDERALLY INSPECTED PRODUCTION OF BEEF, WESTERN CANADA (MIL. LB)
QBF2 - FEDERALLY INSPECTED PRODUCTION OF BEEF, EASTERN CANADA (MIL. LB)
QBF3 - FEDERALLY INSPECTED PRODUCTION OF BEEF, CANADA (MIL. LB)
RPBF3 - CPI FOR BEEF, CANADA (1971=100)
RPHB3 - CPI FOR HAMBURGER, CANADA (1971=100)
SBW1 - MARKETINGS OF COWS AND BULLS, WESTERN CANADA ('000)
SBW2 - MARKETINGS OF COWS AND BULLS, EASTERN CANADA ('000)
SBW3 - MARKETINGS OF COWS AND BULLS, CANADA ('000)
SHF1 - MARKETINGS OF HEIFERS, WESTERN CANADA ('000)
SHF2 - MARKETINGS OF HEIFERS, EASTERN CANADA ('000)
SHF3 - MARKETINGS OF HEIFERS, CANADA ('000)
SSS1 - MARKETINGS OF STEERS, WESTERN CANADA ('000)
SSS2 - MARKETINGS OF STEERS, EASTERN CANADA ('000)
SSS3 - MARKETINGS OF STEERS, CANADA ('000)
WPSS1 - WHOLESALE PRICE OF STEER CARCASSES (A1), EDMONTON ($/CWT)
WPSS2 - WHOLESALE PRICE OF STEER CARCASSES (A1), TORONTO ($/CWT)

EXOGENOUS:
D19734 - NIXON PRICE FREEZE DUMMY, 1973Q4
D19742 - DUMMY FOR UNUSUAL MARKETINGS OF CATTLE IN 1974Q2, CANADA
ER34 - CANADA-U.S.A. EXCHANGE RATE ($CAN./$U.S.A.)
FPCO2 - PRICE OF NO. 2 YELLOW CORN ON TRACK, CHATHAM ($/T)
JS1 - SEASONAL DUMMY, FIRST QUARTER
JS2 - SEASONAL DUMMY, SECOND QUARTER
JS3 - SEASONAL DUMMY, THIRD QUARTER
JS4 - SEASONAL DUMMY, FOURTH QUARTER
NT1BF9 - NET TRADE IN BEEF, WESTERN CANADA TO R.O.W. (MIL. LB)
NT2BF9 - NET TRADE IN BEEF, EASTERN CANADA TO R.O.W. (MIL. LB)
OPBA3 - OFF-BOARD PRICE OF BARLEY, PRAIRIES ($/T)
PBOIL3 - BLENDED PRICE OF CRUDE OIL, CANADA ($/BBL)
PBW4 - PRICE OF SLAUGHTER COWS (COMMERCIAL), OMAHA ($/CWT)
PCDY3 - PER CAPITA DISPOSABLE INCOME, CANADA ($)
PHF4 - PRICE OF PRIME SLAUGHTER HEIFERS, OMAHA ($/CWT)
PHG1 - PRICE OF INDEX 100 HOGS, EDMONTON ($/CWT)
PHG2 - PRICE OF INDEX 100 HOGS, TORONTO ($/CWT)
POPN1 - POPULATION OF WESTERN CANADA (MIL.)
POPN2 - POPULATION OF EASTERN CANADA (MIL.)
PSS4 - PRICE OF CHOICE SLAUGHTER STEERS (900-1100 LB), OMAHA ($/CWT)
RFC3 - RATE ON 90-DAY FINANCE COMPANY PAPER, CANADA
RPPK3 - CPI FOR PORK, CANADA (1971=100)
VBBF4 - BY-PRODUCT ALLOWANCE CHOICE BEEF, U.S.A. ($/CWT)
WAPK3 - AVERAGE WEEKLY EARNINGS IN THE SLAUGHTERING AND MEAT PROCESSING INDUSTRY, CANADA ($)
WA3 - AVERAGE WEEKLY EARNINGS - INDUSTRIAL COMPOSITE, CANADA ($)
WPSS4 - WHOLESALE PRICE OF CHOICE STEER BEEF (600-700 LB), EAST COAST U.S.A. ($/CWT)

COEFFICIENT:
CWBF3.0 CWBF3.1 CWBF3.2 CWBF3.3 CWBF3.4 CWBF3.5 CWBF3.6 IBF1.0 IBF1.1 IBF1.2 IBF1.3
IBF1.4 IBF1.5 IBF1.6 IBF2.0 IBF2.1 IBF2.2 IBF2.3 IBF2.4 IBF2.5 IBW1.0 IBW1.1 IBW1.2

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IBW1.3  IBW1.4  IBW1.5  IBW1.6  IBW1.7  IBW1.8  IBW1.9  IBW2.0  IBW2.1  IBW2.2  IBW2.3  IBW2.4
IBW2.5  IBW2.6  IBW2.7  IBW2.8  IBW2.9  IHF1.0  IHF1.1  IHF1.2  IHF1.3  IHF1.4  IHF1.5  IHF1.6
IHF1.7  IHF2.0  IHF2.1  IHF2.2  IHF2.3  IHF2.4  IHF2.5  IHF2.6  IHF2.7  IHF2.8  ISS1.0  ISS1.1
ISS1.2  ISS1.3  ISS1.4  ISS1.5  ISS1.6  ISS1.7  ISS2.0  ISS2.1  ISS2.2  ISS2.3  ISS2.4  ISS2.5
ISS2.6  ISS2.7  ISS2.8  ISS2.9  NTBW1.0  NTBW1.1  NTBW1.2  NTBW1.3  NTBW1.4  NTBW1.5  NTBW1.6
NTBW1.7  NTBW2.0  NTBW2.1  NTBW2.2  NTBW2.3  NTBW2.4  NTBW2.5  NTBW2.6  NTBW2.7  NTHF1.0  NTHF1.1
NTHF1.2  NTHF1.3  NTHF1.4  NTHF1.5  NTHF1.6  NTHF1.7  NTHF2.0  NTHF2.1  NTHF2.2  NTHF2.3  NTHF2.4
NTHF2.5  NTHF2.6  NTHF2.7  NTSS1.0  NTSS1.1  NTSS1.2  NTSS1.3  NTSS1.4  NTSS1.5  NTSS1.6  NTSS1.7
NTSS2.0  NTSS2.1  NTSS2.2  NTSS2.3  NTSS2.4  NTSS2.5  NTSS2.6  NTSS2.7  NT1BF2.0  NT1BF2.1
NT1BF2.2  NT1BF2.3  NT1BF2.4  NT1BF2.5  NT1BF2.6  NT1BF4.0  NT1BF4.1  NT1BF4.2  NT1BF4.3
NT1BF4.4  NT1BF4.5  NT1BF4.6  NT1BF4.7  NT2BF4.0  NT2BF4.1  NT2BF4.2  NT2BF4.3  NT2BF4.4
NT2BF4.5  NT2BF4.6  NT2BF4.7  PBW1.0  PBW1.1  PBW1.2  PBW1.3  PBW1.4  PBW1.5  PBW1.6  PBW1.7
PBW1.8  PBW2.0  PBW2.1  PBW2.2  PBW2.3  PBW2.4  PBW2.5  PBW2.6  PBW2.7  PBW2.8  PCBF3.0  PCBF3.1
PCBF3.2  PCBF3.3  PCBF3.4  PCBF3.5  PCBF3.6  PCBF3.7  PFC1.0  PFC1.1  PFC1.2  PFC1.3  PFC1.4
PFC1.5  PFC1.6  PFC2.0  PFC2.1  PFC2.2  PFC2.3  PFC2.4  PFC2.5  PFC2.6  PHF1.0  PHF1.1  PHF1.2
PHF1.3  PHF1.4  PHF1.5  PHF1.6  PHF1.7  PHF2.0  PHF2.1  PHF2.2  PHF2.3  PHF2.4  PHF2.5  PHF2.6
PHF2.7  PSS1.0  PSS1.1  PSS1.2  PSS1.3  PSS1.4  PSS1.5  PSS1.6  PSS1.7  PSS2.0  PSS2.1  PSS2.2
PSS2.3  PSS2.4  PSS2.5  PSS2.6  PSS2.7  RPBF3.0  RPBF3.1  RPBF3.2  RPBF3.3  RPBF3.4  RPBF3.5
RPHB3.0  RPHB3.1  RPHB3.2  RPHB3.3  RPHB3.4  RPHB3.5  SBW1.0  SBW1.1  SBW1.2  SBW1.3  SBW1.4
SBW1.5  SBW1.6  SBW1.7  SBW2.0  SBW2.1  SBW2.2  SBW2.3  SBW2.4  SBW2.5  SBW2.6  SBW2.7  SHF1.0
SHF1.1  SHF1.2  SHF1.3  SHF1.4  SHF1.5  SHF1.6  SHF1.7  SHF2.0  SHF2.1  SHF2.2  SHF2.3  SHF2.4
SHF2.5  SHF2.6  SHF2.7  SHF2.8  SHF2.9  SSS1.0  SSS1.1  SSS1.2  SSS1.3  SSS1.4  SSS1.5  SSS1.6
SSS1.7  SSS1.8  SSS2.0  SSS2.1  SSS2.10  SSS2.2  SSS2.3  SSS2.4  SSS2.5  SSS2.6  SSS2.7  SSS2.8
SSS2.9
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EQUATIONS

COLD STORAGE STOCKS DEMAND FOR BEEF, WESTERN CANADA:

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1:      IBF1 = IBF1.0+IBF1.1*JS1+IBF1.2*JS2+IBF1.3*JS3+IBF1.4*QBF1+IBF1.5*IBF1(-1)+IBF1.6*
        WPSS1
```

WHOLESALE-TO-FARM STEER PRICE TRANSMISSION, WESTERN CANADA:

```
2:      PSS1-PSS1(-1) = PSS1.0+PSS1.1*JS1+PSS1.2*JS2+PSS1.3*JS3+PSS1.4*(WPSS1-WPSS1(-1))+
        PSS1.5*(DSS1-DSS1(-1))+PSS1.6*(WAPK3-WAPK3(-1))+PSS1.7*(VBBF4-VBBF4(-1))
```

WHOLESALE-TO-FARM HEIFER PRICE TRANSMISSION, WESTERN CANADA:

```
3:      PHF1-PHF1(-1) = PHF1.0+PHF1.1*JS1+PHF1.2*JS2+PHF1.3*JS3+PHF1.4*(WPSS1-WPSS1(-1))+
        PHF1.5*(DHF1-DHF1(-1))+PHF1.6*(WAPK3-WAPK3(-1))+PHF1.7*(VBBF4-VBBF4(-1))
```

WHOLESALE-TO-FARM COW PRICE TRANSMISSION, WESTERN CANADA:

```
4:      PBW1 = PBW1.0+PBW1.1*JS1+PBW1.2*JS2+PBW1.3*JS3+PBW1.4*WPSS1+PBW1.5*DBW1+PBW1.6*WAPK3+
        PBW1.7*VBBF4+PBW1.8*PBW1(-1)
```

STEER MARKETINGS, WESTERN CANADA:

```
5:      SSS1 = SSS1.0*SSS1(-1)+SSS1.1*JS1*IBW1(-8)+SSS1.2*JS2*IBW1(-8)+SSS1.3*JS3*IBW1(-8)+
        SSS1.4*JS4*IBW1(-8)+SSS1.5*JS1+SSS1.6*JS2+SSS1.7*JS3+SSS1.8*JS4
```

HEIFER MARKETINGS, WESTERN CANADA:

```
6:      SHF1 = SHF1.0+SHF1.1*JS1+SHF1.2*JS2+SHF1.3*JS3+SHF1.4*OPBA3(-7)+SHF1.5*SHF1(-1)+SHF1.6
        *IHF1(-1)+SHF1.7*PFC1(-4)
```

COW AND BULL MARKETINGS, WESTERN CANADA:

```
7:      SBW1 = SBW1.0+SBW1.1*JS1+SBW1.2*JS2+SBW1.3*JS3+SBW1.4*SBW1(-1)+SBW1.5*IBW1(-1)+SBW1.6*
        PFC1(-1)+SBW1.7*PHG1(-1)
```

```
   INVENTORY DEMAND FOR STEERS, WESTERN CANADA:
 8:        ISS1 = ISS1.0*JS1*IBW1(-6)+ISS1.1*JS2*IBW1(-6)+ISS1.2*JS3*IBW1(-6)+ISS1.3*JS4*IBW1(-6)
           +ISS1.4*JS1+ISS1.5*JS2+ISS1.6*JS3+ISS1.7*JS4

   INVENTORY DEMAND FOR HEIFERS, WESTERN CANADA:
 9:        IHF1 = IHF1.0+IHF1.1*SHF1+IHF1.2*IHF1(-1)+IHF1.3*PFC1(-1)+IHF1.4*JS1+IHF1.5*JS2+IHF1.6
           *JS3+IHF1.7*IBW1(-9)

   INVENTORY DEMAND FOR COWS AND BULLS, WESTERN CANADA:
10:        IBW1 = IBW1.0+IBW1.1*JS1+IBW1.2*JS2+IBW1.3*JS3+IBW1.4*SBW1+IBW1.5*PFC1(-3)+IBW1.6*RFC3
           (-3)+IBW1.7*IBW1(-1)+IBW1.8*(SHF1(-6)/SSS1(-6))+IBW1.9*PHF1(-3)

   STEER-TO-FEEDER-CALF PRICE TRANSMISSION, WESTERN CANADA:
11:        PFC1 = PFC1.0+PFC1.1*JS1+PFC1.2*JS2+PFC1.3*JS3+PFC1.4*PSS1(-1)+PFC1.5*OPBA3(-1)+PFC1.6
           *PFC2

   BEEF PRODUCTION IDENTITY, WESTERN CANADA:
12:        QBF1 = CWBF3*(DHF1+DSS1+DBW1)/1000

   BEEF DISAPPEARANCE IDENTITY, WESTERN CANADA:
13:        DBF1 = PCDBF3*POPN1

   BEEF SUPPLY-DISAPPEARANCE IDENTITY, WESTERN CANADA:
14:        DBF1 = QBF1+IBF1(-1)-IBF1-NT1BF2-NT1BF4-NT1BF9

   HEIFER SUPPLY-DEMAND IDENTITY, WESTERN CANADA:
15:        DHF1 = SHF1-NTHF1

   STEER SUPPLY-DEMAND IDENTITY, WESTERN CANADA:
16:        DSS1 = SSS1-NTSS1

   COW AND BULL SUPPLY-DEMAND IDENTITY, WESTERN CANADA:
17:        DBW1 = SBW1-NTBW1

   AVERAGE CARCASS WEIGHT FOR ALL CATTLE SLAUGHTERED, CANADA:
18:        CWBF3 = CWBF3.0+CWBF3.1*JS1+CWBF3.2*JS2+CWBF3.3*JS3+CWBF3.4*PSS1(-2)+CWBF3.5*OPBA3(-2)
           +CWBF3.6*CWBF3(-1)

   EASTERN-TO-WESTERN CANADA WHOLESALE STEER PRICE TRANSMISSION:
19:        NT1BF2 = NT1BF2.0+NT1BF2.1*JS1+NT1BF2.2*JS2+NT1BF2.3*JS3+NT1BF2.4*WPSS1+NT1BF2.5*WPSS2
           +NT1BF2.6*NT1BF2(-1)

   WHOLESALE-STEER-TO-RETAIL-BEEF PRICE TRANSMISSION, CANADA:
20:        RPBF3 = RPBF3.0+RPBF3.1*(WPSS1+WPSS2)/2+RPBF3.2*(0.2*WA3+PBOIL3)+RPBF3.3*(IBF1(-1)+
           IBF2(-1))+RPBF3.4*ER34+RPBF3.5*RPBF3(-1)

   PER CAPITA DISAPPEARANCE OF BEEF, CANADA (INVERTED FUNCTION):
21:        RPBF3 = PCBF3.0+PCBF3.1*JS1+PCBF3.2*JS2+PCBF3.3*JS3+PCBF3.4*PCDBF3+PCBF3.5*RPBF3(-1)+
           PCBF3.6*RPPK3+PCBF3.7*PCDY3

   COLD STORAGE STOCKS DEMAND FOR BEEF, EASTERN CANADA:
22:        IBF2 = IBF2.0+IBF2.1*JS1+IBF2.2*JS2+IBF2.3*JS3+IBF2.4*QBF2+IBF2.5*IBF2(-1)
```

```
   WHOLESALE-TO-FARM STEER PRICE TRANSMISSION, EASTERN CANADA:
23:        PSS2-PSS2(-1) = PSS2.0+PSS2.1*JS1+PSS2.2*JS2+PSS2.3*JS3+PSS2.4*(WPSS2-WPSS2(-1))+
           PSS2.5*(DSS2-DSS2(-1))+PSS2.6*(WAPK3-WAPK3(-1))+PSS2.7*(VBBF4-VBBF4(-1))

   WHOLESALE-TO-FARM HEIFER PRICE TRANSMISSION, EASTERN CANADA:
24:        PHF2-PHF2(-1) = PHF2.0+PHF2.1*JS1+PHF2.2*JS2+PHF2.3*JS3+PHF2.4*(WPSS2-WPSS2(-1))+
           PHF2.5*(DHF2-DHF2(-1))+PHF2.6*(WAPK3-WAPK3(-1))+PHF2.7*(VBBF4-VBBF4(-1))

   WHOLESALE-TO-FARM COW PRICE TRANSMISSION, EASTERN CANADA:
25:        PBW2 = PBW2.0+PBW2.1*JS1+PBW2.2*JS2+PBW2.3*JS3+PBW2.4*WPSS2+PBW2.5*DBW2+PBW2.6*WAPK3+
           PBW2.7*VBBF4+PBW2.8*PBW2(-1)

   STEER MARKETINGS, EASTERN CANADA:
26:        SSS2 = SSS2.0+SSS2.1*JS1+SSS2.2*JS2+SSS2.3*JS3+SSS2.4*PSS2(-8)+SSS2.5*FPCO2(-9)+SSS2.6
           *PFC2(-7)+SSS2.7*SSS2(-1)+SSS2.8*D19734+SSS2.9*ISS2(-1)+SSS2.10*D19742

   HEIFER MARKETINGS, EASTERN CANADA:
27:        SHF2 = SHF2.0+SHF2.1*JS1+SHF2.2*JS2+SHF2.3*JS3+SHF2.4*FPCO2(-9)+SHF2.5*IHF2(-1)+SHF2.6
           *SHF2(-1)+SHF2.7*PHF2(-8)+SHF2.8*D19734+SHF2.9*D19742

   COW AND BULL MARKETINGS, EASTERN CANADA:
28:        SBW2 = SBW2.0+SBW2.1*JS1+SBW2.2*JS2+SBW2.3*JS3+SBW2.4*SBW2(-1)+SBW2.5*IBW2(-1)+SBW2.6*
           PFC2(-1)+SBW2.7*PHG2(-1)

   INVENTORY DEMAND FOR STEERS, EASTERN CANADA:
29:        ISS2 = ISS2.0+ISS2.1*SSS2+ISS2.2*ISS2(-1)+ISS2.3*IBW2(-9)+ISS2.4*JS1+ISS2.5*JS2+ISS2.6
           *JS3+ISS2.7*PFC2(-7)+ISS2.8*FPCO2(-2)+ISS2.9*D19742

   INVENTORY DEMAND FOR HEIFERS, EASTERN CANADA:
30:        IHF2 = IHF2.0+IHF2.1*SHF2+IHF2.2*IHF2(-1)+IHF2.3*IBW2(-12)+IHF2.4*JS1+IHF2.5*JS2+
           IHF2.6*JS3+IHF2.7*PFC2(-9)+IHF2.8*PHF2(-1)

   INVENTORY DEMAND FOR COWS AND BULLS, EASTERN CANADA:
31:        IBW2 = IBW2.0+IBW2.1*JS1+IBW2.2*JS2+IBW2.3*JS3+IBW2.4*PHF2(-3)+IBW2.5*PFC2(-3)+IBW2.6*
           FPCO2(-3)+IBW2.7*IBW2(-1)+IBW2.8*(SHF2(-6)/SSS2(-6))+IBW2.9*SBW2

   STEER-TO-FEEDER-CALF PRICE TRANSMISSION, EASTERN CANADA:
32:        PFC2 = PFC2.0+PFC2.1*JS1+PFC2.2*JS2+PFC2.3*JS3+PFC2.4*PSS2(-1)+PFC2.5*FPCO2(-1)+PFC2.6
           *PFC2(-1)

   BEEF PRODUCTION IDENTITY, EASTERN CANADA:
33:        QBF2 = CWBF3*(DHF2+DSS2+DBW2)/1000

   BEEF DISAPPEARANCE IDENTITY, EASTERN CANADA:
34:        DBF2 = PCDBF3*POPN2

   BEEF SUPPLY-DISAPPEARANCE IDENTITY, EASTERN CANADA:
35:        DBF2 = QBF2+IBF2(-1)-IBF2+NT1BF2-NT2BF4-NT2BF9

   HEIFER SUPPLY-DEMAND IDENTITY, EASTERN CANADA:
36:        DHF2 = SHF2-NTHF2

   STEER SUPPLY-DEMAND IDENTITY, EASTERN CANADA:
37:        DSS2 = SSS2-NTSS2
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   COW AND BULL SUPPLY-DEMAND IDENTITY, EASTERN CANADA:
38:        DBW2 = SBW2-NTBW2

   U.S.A.-TO-WESTERN-CANADA HEIFER PRICE TRANSMISSION (INVERTED FUNCTION):
39:        NTHF1 = NTHF1.0+NTHF1.1*JS1+NTHF1.2*JS2+NTHF1.3*JS3+NTHF1.4*ER34+NTHF1.5*PHF4+NTHF1.6*
           PHF1+NTHF1.7*NTHF1(-1)

   U.S.A.-TO-WESTERN-CANADA STEER PRICE TRANSMISSION (INVERTED FUNCTION):
40:        NTSS1 = NTSS1.0+NTSS1.1*JS1+NTSS1.2*JS2+NTSS1.3*JS3+NTSS1.4*ER34+NTSS1.5*PSS4+NTSS1.6*
           PSS1+NTSS1.7*NTSS1(-1)

   U.S.A.-TO-WESTERN-CANADA COW PRICE TRANSMISSION (INVERTED FUNCTION):
41:        NTBW1 = NTBW1.0+NTBW1.1*JS1+NTBW1.2*JS2+NTBW1.3*JS3+NTBW1.4*ER34+NTBW1.5*PBW4+NTBW1.6*
           PBW1+NTBW1.7*NTBW1(-1)

   U.S.A.-TO-WESTERN-CANADA WHOLESALE STEER PRICE TRANSMISSION
    (INVERTED FUNCTION):
42:        NT1BF4 = NT1BF4.0+NT1BF4.1*JS1+NT1BF4.2*JS2+NT1BF4.3*JS3+NT1BF4.4*ER34+NT1BF4.5*WPSS1+
           NT1BF4.6*WPSS4+NT1BF4.7*NT1BF4(-1)

   U.S.A.-TO-EASTERN-CANADA HEIFER PRICE TRANSMISSION (INVERTED FUNCTION):
43:        NTHF2 = NTHF2.0+NTHF2.1*JS1+NTHF2.2*JS2+NTHF2.3*JS3+NTHF2.4*ER34+NTHF2.5*PHF4+NTHF2.6*
           PHF2+NTHF2.7*NTHF2(-1)

   U.S.A.-TO-EASTERN-CANADA STEER PRICE TRANSMISSIOM (INVERTED FUNCTION):
44:        NTSS2 = NTSS2.0+NTSS2.1*JS1+NTSS2.2*JS2+NTSS2.3*JS3+NTSS2.4*ER34+NTSS2.5*PSS4+NTSS2.6*
           PSS2+NTSS2.7*NTSS2(-1)

   U.S.A.-TO-EASTERN-CANADA COW PRICE TRANSMISSION (INVERTED FUNCTION):
45:        NTBW2 = NTBW2.0+NTBW2.1*JS1+NTBW2.2*JS2+NTBW2.3*JS3+NTBW2.4*ER34+NTBW2.5*PBW4+NTBW2.6*
           PBW2+NTBW2.7*NTBW2(-1)

   U.S.A.-TO-EASTERN-CANADA WHOLESALE STEER PRICE TRANSMISSION
    (INVERTED FUNCTION):
46:        NT2BF4 = NT2BF4.0+NT2BF4.1*JS1+NT2BF4.2*JS2+NT2BF4.3*JS3+NT2BF4.4*ER34+NT2BF4.5*WPSS2+
           NT2BF4.6*WPSS4+NT2BF4.7*NT2BF4(-1)

   C.P.I. FOR HAMBURGER, CANADA:
47:        RPHB3 = RPHB3.0+RPHB3.1*JS1+RPHB3.2*JS2+RPHB3.3*JS3+RPHB3.4*RPBF3+RPHB3.5*RPHB3(-1)

   DISAPPEARANCE OF BEEF, CANADA:
48:        DBF3 = DBF1+DBF2

   PRODUCTION OF BEEF, CANADA:
49:        QBF3 = QBF1+QBF2

   COW AND BULL SLAUGHTER, CANADA:
50:        DBW3 = DBW1+DBW2

   HEIFER SLAUGHTER, CANADA:
51:        DHF3 = DHF1+DHF2

   STEER SLAUGHTER, CANADA:
52:        DSS3 = DSS1+DSS2
```

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   COW AND BULL MARKETINGS, CANADA:
53:        SBW3 = SBW1+SBW2

   HEIFER MARKETINGS, CANADA:
54:        SHF3 = SHF1+SHF2

   STEER MARKETINGS, CANADA:
55:        SSS3 = SSS1+SSS2

   NET TRADE IN COWS AND BULLS, CANADA:
56:        NTBW3 = NTBW1+NTBW2

   NET TRADE IN HEIFERS, CANADA:
57:        NTHF3 = NTHF1+NTHF2

   NET TRADE IN STEERS, CANADA:
58:        NTSS3 = NTSS1+NTSS2

   INVENTORY OF COWS AND BULLS, CANADA:
59:        IBW3 = IBW1+IBW2

   INVENTORY OF HEIFERS, CANADA:
60:        IHF3 = IHF1+IHF2

   INVENTORY OF STEERS, CANADA:
61:        ISS3 = ISS1+ISS2

   CLOSING STOCKS OF BEEF, CANADA:
62:        IBF3 = IBF1+IBF2

   NET TRADE IN BEEF, CANADA TO THE U.S.A.:
63:        NT3BF4 = NT1BF4+NT2BF4
```

MODEL: PORK

SYMBOL DECLARATIONS

ENDOGENOUS:

CWHG1	- AVERAGE HOG CARCASS WEIGHT, WESTERN CANADA (LB/HD)
CWHG2	- AVERAGE HOG CARCASS WEIGHT, EASTERN CANADA (LB/HD)
CWHG3	- AVERAGE HOG CARCASS WEIGHT, CANADA (LB/HD)
DHG1	- SLAUGHTER OF HOGS, WESTERN CANADA ('000)
DHG2	- SLAUGHTER OF HOGS, EASTERN CANADA ('000)
DHG3	- SLAUGHTER OF HOGS, CANADA ('000)
DPK1	- DISAPPEARANCE OF PORK, WESTERN CANADA (MIL. LB)
DPK2	- DISAPPEARANCE OF PORK, EASTERN CANADA (MIL. LB)
DPK3	- DISAPPEARANCE OF PORK, CANADA (MIL. LB)
IHG1	- CLOSING PIGS ON FARMS, WESTERN CANADA (000)
IHG2	- CLOSING PIGS ON FARMS, EASTERN CANADA (000)
IHG3	- CLOSING PIGS ON FARMS, CANADA (000)
IPK1	- CLOSING STOCKS OF PORK, WESTERN CANADA (MIL. LB)
IPK2	- CLOSING STOCKS OF PORK, EASTERN CANADA (MIL. LB)
IPK3	- CLOSING STOCKS OF PORK, CANADA (MIL. LB)
NT1PK2	- NET TRADE IN PORK, WESTERN TO EASTERN CANADA (MIL. LB)
NT1PK4	- NET TRADE IN PORK, WESTERN CANADA TO THE U.S.A. (MIL. LB)
NT2PK4	- NET TRADE IN PORK, EASTERN CANADA TO THE U.S.A. (MIL. LB)
NT3PK4	- NET TRADE IN PORK, CANADA TO THE U.S.A. (MIL. LB)
PCDPK3	- PER CAPITA DISAPPEARANCE OF PORK, CANADA (LB)
PHG1	- PRICE OF INDEX 100 HOGS, EDMONTON ($/CWT)
PHG2	- PRICE OF INDEX 100 HOGS, TORONTO ($/CWT)
QPK1	- PRODUCTION OF PORK, WESTERN CANADA (MIL. LB)
QPK2	- PRODUCTION OF PORK, EASTERN CANADA (MIL. LB)
QPK3	- PRODUCTION OF PORK, CANADA (MIL. LB)
RPPK3	- CPI FOR PORK, CANADA (1971=100)
SHG1	- MARKETINGS OF HOGS, WESTERN CANADA ('000)
SHG2	- MARKETINGS OF HOGS, EASTERN CANADA ('000)
SHG3	- MARKETINGS OF HOGS, CANADA ('000)

EXOGENOUS:

DQUE	- DUMMY FOR SUDDEN INCREASE PRODUCTION OF HOGS IN QUEBEC (AS OF 1977)
D19712	- DUMMY FOR CHANGE IN PORK STOCK HOLDING BEHAVIOUR, CANADA (1971Q2)
ER34	- CANADA-U.S.A. EXCHANGE RATE ($CAN./$U.S.A.)
FIGR3	- FARM INVENTORY OF OATS, BARLEY AND WHEAT, CANADA (MIL. T)
FPC02	- PRICE OF NO. 2 YELLOW CORN ON TRACK, CHATHAM ($/T)
JS1	- SEASONAL DUMMY, FIRST QUARTER
JS2	- SEASONAL DUMMY, SECOND QUARTER
JS3	- SEASONAL DUMMY, THIRD QUARTER
NTHG1	- NET TRADE IN HOGS, WESTERN CANADA ('000)
NTHG2	- NET TRADE IN HOGS, EASTERN CANADA ('000)
NT1PK9	- NET TRADE IN PORK, WESTERN CANADA TO R.O.W. (MIL. LB)
NT2PK9	- NET TRADE IN PORK, EASTERN CANADA TO R.O.W. (MIL. LB)
OPBA3	- OFF-BOARD PRICE OF BARLEY, PRAIRIES ($/T)
PBOIL3	- BLENDED PRICE OF CRUDE OIL, CANADA ($/BBL)
PCDY3	- PER CAPITA DISPOSABLE INCOME, CANADA ($)
PHG4	- PRICE OF BARROWS AND GILTS AT SEVEN MARKETS, U.S.A. ($/CWT)
POPN1	- POPULATION OF WESTERN CANADA (MIL.)

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POPN2    - POPULATION OF EASTERN CANADA (MIL.)
RFC3     - RATE ON 90-DAY FINANCE COMPANY PAPER, CANADA
RPBF3    - CPI FOR BEEF, CANADA (1971=100)
RPCK3    - CPI FOR CHICKEN, CANADA (1971=100)
RPNF3    - CPI FOR ALL ITEMS EXCLUDING FOOD, CANADA (1971=100)
WAPK3    - AVERAGE WEEKLY EARNINGS IN THE SLAUGHTERING AND MEAT
           PROCESSING INDUSTRY, CANADA ($)

COEFFICIENT:
   CWHG1.0  CWHG1.1  CWHG1.2  CWHG1.3  CWHG1.4  CWHG1.5  CWHG1.6  CWHG2.0  CWHG2.1  CWHG2.2  CWHG2.3
   CWHG2.4  CWHG2.5  CWHG2.6  IHG1.0  IHG1.1  IHG1.2  IHG1.3  IHG1.4  IHG1.5  IHG1.6  IHG1.7  IHG2.0
   IHG2.1  IHG2.2  IHG2.3  IHG2.4  IHG2.5  IHG2.6  IHG2.7  IPK1.0  IPK1.1  IPK1.2  IPK1.3  IPK1.4
   IPK1.5  IPK1.6  IPK2.0  IPK2.1  IPK2.2  IPK2.3  IPK2.4  IPK2.5  IPK2.6  PCPK3.0  PCPK3.1  PCPK3.2
   PCPK3.3  PCPK3.4  PCPK3.5  PCPK3.6  PCPK3.7  PCPK3.8  PHG1.A  PHG1.B  PHG1.C  PHG1.D  PHG1.E
   PHG1.F  PHG1.G  PHG1.H  PHG1.0  PHG1.1  PHG1.2  PHG1.3  PHG1.4  PHG1.5  PHG1.6  PHG2.A  PHG2.B
   PHG2.C  PHG2.D  PHG2.E  PHG2.F  PHG2.G  PHG2.H  RPPK3.0  RPPK3.1  RPPK3.2  RPPK3.3  RPPK3.4
   RPPK3.5  RPPK3.6  RPPK3.7  RPPK3.8  SHG1.0  SHG1.1  SHG1.2  SHG1.3  SHG1.4  SHG1.5  SHG2.0
   SHG2.1  SHG2.2  SHG2.3  SHG2.4  SHG2.5


EQUATIONS


     COLD STORAGE STOCKS DEMAND FOR PORK, WESTERN CANADA:
1:       IPK1 = IPK1.0+IPK1.1*JS1+IPK1.2*JS2+IPK1.3*JS3+IPK1.4*QPK1+IPK1.5*IPK1(-1)+IPK1.6*
         D19712

     AVERAGE HOG CARCASS WEIGHT, WESTERN CANADA:
2:       CWHG1 = CWHG1.0+CWHG1.1*JS1+CWHG1.2*JS2+CWHG1.3*JS3+CWHG1.4*PHG1(-1)+CWHG1.5*OPBA3(-3)
         +CWHG1.6*CWHG1(-1)

     INVENTORY DEMAND FOR HOGS, WESTERN CANADA:
3:       IHG1 = IHG1.0+IHG1.1*JS1+IHG1.2*JS2+IHG1.3*JS3+IHG1.4*PHG1(-2)+IHG1.5*OPBA3(-2)+IHG1.6
         *JS3*FIGR3+IHG1.7*IHG1(-1)

     MARKETINGS OF HOGS, WESTERN CANADA:
4:       SHG1 = SHG1.0+SHG1.1*JS1+SHG1.2*JS2+SHG1.3*JS3+SHG1.4*IHG1(-1)+SHG1.5*SHG1(-1)

     PORK DISAPPEARANCE IDENTITY, WESTERN CANADA:
5:       DPK1 = PCDPK3*POPN1

     PORK PRODUCTION IDENTITY, WESTERN CANADA:
6:       QPK1 = CWHG1*DHG1/1000

     PORK SUPPLY-DISAPPEARANCE IDENTITY, WESTERN CANADA:
7:       DPK1 = QPK1+IPK1(-1)-IPK1-NT1PK2-NT1PK4-NT1PK9

     HOG SUPPLY-DEMAND IDENTITY, WESTERN CANADA:
8:       DHG1 = SHG1-NTHG1

     HOG PRICE TRANSMISSION, EASTERN TO WESTERN CANADA:
9:       PHG1 = PHG1.0+PHG1.1*JS1+PHG1.2*JS2+PHG1.3*JS3+PHG1.4*PHG2+PHG1.5*NT1PK2+PHG1.6*PHG1(
         -1)
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   HOG TO RETAIL PORK PRICE TRANSMISSION, CANADA:
10:        RPPK3 = RPPK3.0+RPPK3.1*JS1*PHG2+RPPK3.2*JS2*PHG2+RPPK3.3*JS3*PHG2+RPPK3.4*PHG2+
           RPPK3.5*(0.2*WAPK3+PBOIL3)+RPPK3.6*ER34+RPPK3.7*(IPK1(-1)+IPK2(-1))+RPPK3.8*RPPK3(-1)

   PER CAPITA DISAPPEARANCE OF PORK, CANADA (INVERTED FUNCTION):
11:        RPPK3 = PCPK3.0+PCPK3.1*JS1+PCPK3.2*JS2+PCPK3.3*JS3+PCPK3.4*PCDPK3+PCPK3.5*RPBF3+
           PCPK3.6*PCDY3+PCPK3.7*RPNF3+PCPK3.8*RPCK3

   COLD STORAGE STOCKS DEMAND FOR PORK, EASTERN CANADA:
12:        IPK2 = IPK2.0+IPK2.1*JS1+IPK2.2*JS2+IPK2.3*JS3+IPK2.4*QPK2+IPK2.5*IPK2(-1)+IPK2.6*
           D19712

   INVENTORY DEMAND FOR HOGS, EASTERN CANADA:
13:        IHG2 = IHG2.0+IHG2.1*JS1+IHG2.2*JS2+IHG2.3*JS3+IHG2.4*PHG2(-2)+IHG2.5*FPCO2(-2)+IHG2.6
           *RFC3(-2)+IHG2.7*DQUE

   AVERAGE HOG CARCASS WEIGHT, EASTERN CANADA:
14:        CWHG2 = CWHG2.0+CWHG2.1*JS1+CWHG2.2*JS2+CWHG2.3*JS3+CWHG2.4*PHG2(-1)+CWHG2.5*FPCO2(-3)
           +CWHG2.6*CWHG2(-1)

   MARKETINGS OF HOGS, EASTERN CANADA:
15:        SHG2 = SHG2.0+SHG2.1*JS1+SHG2.2*JS2+SHG2.3*JS3+SHG2.4*IHG2(-1)+SHG2.5*SHG2(-1)

   PORK DISAPPEARANCE IDENTITY, EASTERN CANADA:
16:        DPK2 = PCDPK3*POPN2

   PORK PRODUCTION IDENTITY, EASTERN CANADA:
17:        QPK2 = DHG2*CWHG2/1000

   PORK SUPPLY-DISAPPEARANCE IDENTITY, EASTERN CANADA:
18:        DPK2 = QPK2+IPK2(-1)-IPK2+NT1PK2-NT2PK4-NT2PK9

   HOG SUPPLY-DEMAND IDENTITY, EASTERN CANADA:
19:        DHG2 = SHG2-NTHG2

   HOG PRICE TRANSMISSION, U.S.A. TO WESTERN CANADA:
20:        PHG1 = PHG1.A+PHG1.B*JS1+PHG1.C*JS2+PHG1.D*JS3+PHG1.E*ER34+PHG1.F*NT1PK4+PHG1.G*PHG4+
           PHG1.H*PHG1(-1)

   HOG PRICE TRANSMISSION, U.S.A. TO EASTERN CANADA:
21:        PHG2 = PHG2.A+PHG2.B*JS1+PHG2.C*JS2+PHG2.D*JS3+PHG2.E*ER34+PHG2.F*NT2PK4+PHG2.G*PHG4+
           PHG2.H*PHG2(-1)

   DISAPPEARANCE OF PORK, CANADA:
22:        DPK3 = DPK1+DPK2

   PRODUCTION OF PORK, CANADA:
23:        QPK3 = QPK1+QPK2

   HOG MARKETINGS, CANADA:
24:        SHG3 = SHG1+SHG2

   HOG SLAUGHTER, CANADA:
25:        DHG3 = DHG1+DHG2
```

```
   NET TRADE IN PORK, CANADA TO THE U.S.A.:
26:        NT3PK4 = NT1PK4+NT2PK4

   CLOSING STOCKS OF PORK, CANADA:
27:        IPK3 = IPK1+IPK2

   AVERAGE HOG CARCASS WEIGHT, CANADA:
28:        CWHG3 = CWHG1*DHG1/DHG3+CWHG2*DHG2/DHG3

   INVENTORY OF HOGS, CANADA:
29:        IHG3 = IHG1+IHG2
```

APPENDIX 11C: ESTIMATION RESULTS

1: IBF1 = IBF1.0+IBF1.1*JS1+IBF1.2*JS2+IBF1.3*JS3+IBF1.4*QBF1+IBF1.5*IBF1(-1)+IBF1.6*WPSS1

NOB = 46 NOVAR = 7
RANGE = 1970 1 TO 1981 2
RSQ = 0.81017 CRSQ = 0.78097 F(6/39) = 27.741
SER = 1.6351 SSR = 104.274 DW(0) = 1.77 COND(X) = 28.99
LHS MEAN = 12.41390 SR = 0.00009

COEF	VALUE	ST ER	T-STAT	MEAN
IBF1.0	-3.85256	2.06548	-1.86521	1.00000
IBF1.1	0.07220	0.72768	0.09922	0.26087
IBF1.2	-1.72203	0.82328	-2.09166	0.26087
IBF1.3	-2.80189	0.72876	-3.84472	0.23913
IBF1.4	0.04415	0.00923	4.78295	271.77900
IBF1.5	0.48318	0.10062	4.80206	12.52920
IBF1.6	-0.00786	0.00869	-0.90527	87.35010

2: PSS1-PSS1(-1) = PSS1.0+PSS1.1*JS1+PSS1.2*JS2+PSS1.3*JS3+PSS1.4*(WPSS1-WPSS1(-1))+PSS1.5*(DSS1-DSS1(-1))+PSS1.6*(WAPK3-WAPK3(-1))+PSS1.7*(VBBF4-VBBF4(-1))

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.94374 CRSQ = 0.93281 F(7/36) = 86.277
SER = 1.1207 SSR = 45.219 DW(0) = 2.59 COND(X) = 4.91
LHS MEAN = 1.18750 SR = 0.00005

COEF	VALUE	ST ER	T-STAT	MEAN
PSS1.0	0.21376	0.37236	0.57407	1.00000
PSS1.1	-0.47277	0.50434	-0.93740	0.25000
PSS1.2	0.36913	0.64977	0.56810	0.25000
PSS1.3	-0.62343	0.48691	-1.28038	0.25000
PSS1.4	0.46530	0.03301	14.09790	2.15788
PSS1.5	-0.01787	0.01090	-1.63971	-0.52245
PSS1.6	-0.00428	0.04856	-0.08816	4.99416
PSS1.7	0.60787	0.10405	5.84205	0.26894

3: PHF1-PHF1(-1) = PHF1.0+PHF1.1*JS1+PHF1.2*JS2+PHF1.3*JS3+PHF1.4*(WPSS1-WPSS1(-1))+PHF1.5*(DHF1-DHF1(-1))+PHF1.6*(WAPK3-WAPK3(-1))+PHF1.7*(VBBF4-VBBF4(-1))

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.93771 CRSQ = 0.9256 F(7/36) = 77.426

```
SER =   1.1827      SSR =    50.353      DW(0) =  2.26      COND(X) =     5.76
LHS MEAN =      1.18917     SR =       0.00003

COEF          VALUE          ST ER          T-STAT          MEAN

PHF1.0        0.48887        0.43386         1.12678        1.00000
PHF1.1       -0.18186        0.61470        -0.29585        0.25000
PHF1.2        0.15402        0.58989         0.26110        0.25000
PHF1.3       -0.82023        0.65997        -1.24283        0.25000
PHF1.4        0.43459        0.03037        14.31000        2.15788
PHF1.5       -0.03398        0.01097        -3.09635        0.58150
PHF1.6       -0.02785        0.04915        -0.56669        4.99416
PHF1.7        0.49597        0.10916         4.54336        0.26894
```

```
4:  PBW1 = PBW1.0+PBW1.1*JS1+PBW1.2*JS2+PBW1.3*JS3+PBW1.4*WPSS1+PBW1.5*DBW1+PBW1.6*WAPK3+PBW1.7*
VBBF4+PBW1.8*PBW1(-1)


NOB = 60      NOVAR = 9
RANGE =   1966 1 TO 1980 4
RSQ =    0.96797      CRSQ =    0.96295      F(8/51) =    192.672
SER =    2.3870       SSR =    290.579      DW(0) =   1.22      COND(X) =    41.39
LHS MEAN =      28.83070     SR =       0.00187

COEF          VALUE          ST ER          T-STAT          MEAN

PBW1.0        6.17344        2.80996         2.19699        1.00000
PBW1.1        2.17296        1.03588         2.09768        0.25000
PBW1.2        1.43491        1.16953         1.22691        0.25000
PBW1.3       -0.98272        1.01094        -0.97209        0.25000
PBW1.4        0.19562        0.04838         4.04324       75.24610
PBW1.5       -0.05447        0.01910        -2.85174      100.04200
PBW1.6       -0.03066        0.01155        -2.65489      195.08600
PBW1.7        1.03904        0.18538         5.60503       10.29170
PBW1.8        0.28420        0.10489         2.70962       28.20970
```

```
5:  SSS1 = SSS1.0*SSS1(-1)+SSS1.1*JS1*IBW1(-8)+SSS1.2*JS2*IBW1(-8)+SSS1.3*JS3*IBW1(-8)+SSS1.4*JS4
*IBW1(-8)+SSS1.5*JS1+SSS1.6*JS2+SSS1.7*JS3+SSS1.8*JS4


NOB = 44      NOVAR = 9
RANGE =   1970 1 TO 1980 4
RSQ =    0.68004      CRSQ =    0.60691      F(8/35) =      9.299
SER =   15.9672       SSR =   8923.260      DW(0) =   2.16      COND(X) =    37.15
LHS MEAN =      256.90400     SR =       0.00485

COEF          VALUE          ST ER          T-STAT          MEAN

SSS1.0        0.64976        0.14407         4.50993      258.26200
SSS1.1        0.04182        0.01012         4.13338      800.84700
SSS1.2        0.02531        0.01187         2.13183      820.02400
```

SSS1.3	-0.04456	0.01325	-3.36387	808.44900
SSS1.4	0.00623	0.01084	0.57494	796.87500
SSS1.5	-42.25240	49.64880	-0.85103	0.25000
SSS1.6	13.68690	37.56500	0.36435	0.25000
SSS1.7	239.41600	36.30790	6.59404	0.25000
SSS1.8	52.79220	53.97510	0.97808	0.25000

6: SHF1 = SHF1.0+SHF1.1*JS1+SHF1.2*JS2+SHF1.3*JS3+SHF1.4*OPBA3(-7)+SHF1.5*SHF1(-1)+SHF1.6*IHF1(-1)+SHF1.7*PFC1(-4)

NOB = 60 NOVAR = 8
RANGE = 1966 1 TO 1980 4
RSQ = 0.85361 CRSQ = 0.83391 F(7/52) = 43.318
SER = 17.0912 SSR = 15189.700 DW(0) = 2.02 COND(X) = 27.34
LHS MEAN = 129.48200 SR = 0.00099

COEF	VALUE	ST ER	T-STAT	MEAN
SHF1.0	17.01070	16.00600	1.06277	1.00000
SHF1.1	23.33010	7.34731	3.17533	0.25000
SHF1.2	-2.49903	6.24500	-0.40016	0.25000
SHF1.3	23.69160	7.31308	3.23962	0.25000
SHF1.4	0.91941	0.21383	4.29966	55.94050
SHF1.5	0.30991	0.13392	2.31415	128.80100
SHF1.6	0.00769	0.02100	0.36624	814.62600
SHF1.7	0.08357	0.11872	0.70388	44.58650

7: SBW1 = SBW1.0+SBW1.1*JS1+SBW1.2*JS2+SBW1.3*JS3+SBW1.4*SBW1(-1)+SBW1.5*IBW1(-1)+SBW1.6*PFC1(-1)+SBW1.7*PHG1(-1)

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.81694 CRSQ = 0.78135 F(7/36) = 22.951
SER = 17.2459 SSR = 10707.100 DW(0) = 1.82 COND(X) = 44.17
LHS MEAN = 106.47600 SR = 0.00107

COEF	VALUE	ST ER	T-STAT	MEAN
SBW1.0	44.80360	32.46040	1.38026	1.00000
SBW1.1	-34.61310	10.16280	-3.40585	0.25000
SBW1.2	-53.14430	7.92731	-6.70394	0.25000
SBW1.3	-39.49370	7.61483	-5.18642	0.25000
SBW1.4	0.20159	0.14763	1.36554	105.72000
SBW1.5	0.01953	0.01102	1.77294	3338.19000
SBW1.6	-0.62096	0.17938	-3.46172	54.40070
SBW1.7	0.82264	0.31198	2.63687	49.53690

8: ISS1 = ISS1.0*JS1*IBW1(-6)+ISS1.1*JS2*IBW1(-6)+ISS1.2*JS3*IBW1(-6)+ISS1.3*JS4*IBW1(-6)+ISS1.4*JS1+ISS1.5*JS2+ISS1.6*JS3+ISS1.7*JS4

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.94489 CRSQ = 0.93418 F(7/36) = 88.184
SER = 55.6956 SSR = 1.117E+05 DW(0) = 0.40 COND(X) = 15.96
LHS MEAN = 973.63500 SR = 0.00171

COEF	VALUE	ST ER	T-STAT	MEAN
ISS1.0	0.31651	0.03669	8.62563	808.44900
ISS1.1	0.34642	0.03765	9.20104	796.87500
ISS1.2	0.33126	0.03912	8.46696	815.97800
ISS1.3	0.30534	0.03995	7.64219	835.08100
ISS1.4	-55.49670	119.84500	-0.46307	0.25000
ISS1.5	86.34240	121.17800	0.71253	0.25000
ISS1.6	-105.70600	128.79700	-0.82072	0.25000
ISS1.7	-259.47200	134.51200	-1.92899	0.25000

9: IHF1 = IHF1.0+IHF1.1*SHF1+IHF1.2*IHF1(-1)+IHF1.3*PFC1(-1)+IHF1.4*JS1+IHF1.5*JS2+IHF1.6*JS3+IHF1.7*IBW1(-9)

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.93681 CRSQ = 0.92452 F(7/36) = 76.244
SER = 37.1887 SSR = 49787.900 DW(0) = 1.58 COND(X) = 52.41
LHS MEAN = 890.55700 SR = 0.00537

COEF	VALUE	ST ER	T-STAT	MEAN
IHF1.0	0.66135	59.83240	0.01105	1.00000
IHF1.1	0.04434	0.28727	0.15434	138.52300
IHF1.2	0.86772	0.08725	9.94540	884.86400
IHF1.3	0.01895	0.28358	0.06683	54.40070
IHF1.4	279.84600	20.60480	13.58160	0.25000
IHF1.5	302.37500	15.87450	19.04790	0.25000
IHF1.6	19.06870	21.21170	0.89897	0.25000
IHF1.7	-0.01103	0.03260	-0.33830	3210.99000

10: IBW1 = IBW1.0+IBW1.1*JS1+IBW1.2*JS2+IBW1.3*JS3+IBW1.4*SBW1+IBW1.5*PFC1(-3)+IBW1.6*RFC3(-3)+IBW1.7*IBW1(-1)+IBW1.8*(SHF1(-6)/SSS1(-6))+IBW1.9*PHF1(-3)

NOB = 74 NOVAR = 10
RANGE = 1963 1 TO 1981 2
RSQ = 0.99651 CRSQ = 0.99601 F(9/64) = 2028.190
SER = 31.1318 SSR = 62028.200 DW(0) = 1.60 COND(X) = 43.97

LHS MEAN = 3026.12000 SR = 0.06616

COEF	VALUE	ST ER	T-STAT	MEAN
IBW1.0	82.60380	31.08630	2.65724	1.00000
IBW1.1	122.55500	12.23170	10.01950	0.25676
IBW1.2	98.00090	13.82990	7.08614	0.25676
IBW1.3	-16.87450	12.43150	-1.35740	0.24324
IBW1.4	-0.80107	0.16628	-4.81760	106.02400
IBW1.5	2.87760	0.67078	4.28994	43.53580
IBW1.6	-6.03664	2.63597	-2.29010	7.21373
IBW1.7	1.03496	0.01102	93.87410	3011.94000
IBW1.8	-142.60500	32.57470	-4.37779	0.49124
IBW1.9	-4.34490	1.13055	-3.84318	35.21270

11: PFC1 = PFC1.0+PFC1.1*JS1+PFC1.2*JS2+PFC1.3*JS3+PFC1.4*PSS1(-1)+PFC1.5*OPBA3(-1)+PFC1.6*PFC2

NOB = 44 NOVAR = 7
RANGE = 1970 1 TO 1980 4
RSQ = 0.98976 CRSQ = 0.9881 F(6/37) = 595.921
SER = 2.6737 SSR = 264.493 DW(0) = 1.42 COND(X) = 34.79
LHS MEAN = 55.63070 SR = 0.00174

COEF	VALUE	ST ER	T-STAT	MEAN
PFC1.0	-7.01714	1.60898	-4.36125	1.00000
PFC1.1	-1.09491	1.15529	-0.94773	0.25000
PFC1.2	-2.31215	1.15448	-2.00276	0.25000
PFC1.3	-1.59818	1.15708	-1.38122	0.25000
PFC1.4	0.31441	0.10486	2.99830	46.45450
PFC1.5	-0.08870	0.02489	-3.56440	69.55070
PFC1.6	1.00585	0.06665	15.09240	55.14030

18: CWBF3 = CWBF3.0+CWBF3.1*JS1+CWBF3.2*JS2+CWBF3.3*JS3+CWBF3.4*PSS1(-2)+CWBF3.5*OPBA3(-2)+
CWBF3.6*CWBF3(-1)

NOB = 44 NOVAR = 7
RANGE = 1970 1 TO 1980 4
RSQ = 0.85963 CRSQ = 0.83687 F(6/37) = 37.765
SER = 7.1443 SSR = 1888.530 DW(0) = 1.80 COND(X) = 194.15
LHS MEAN = 572.90200 SR = 0.02588

COEF	VALUE	ST ER	T-STAT	MEAN
CWBF3.0	348.28700	66.86540	5.20878	1.00000
CWBF3.1	8.96392	3.06551	2.92412	0.25000
CWBF3.2	4.47031	3.24585	1.37724	0.25000
CWBF3.3	1.08209	3.16587	0.34180	0.25000
CWBF3.4	0.82950	0.16611	4.99355	45.39810

CWBF3.5	-0.28696	0.06307	-4.55019	67.46980
CWBF3.6	0.35402	0.12318	2.87399	572.53600

19: NT1BF2 = NT1BF2.0+NT1BF2.1*JS1+NT1BF2.2*JS2+NT1BF2.3*JS3+NT1BF2.4*WPSS1+NT1BF2.5*WPSS2+NT1BF2.6*NT1BF2(-1)

NOB = 44 NOVAR = 7
RANGE = 1970 1 TO 1980 4
RSQ = 0.79387 CRSQ = 0.76044 F(6/37) = 23.750
SER = 10.5035 SSR = 4081.990 DW(0) = 2.44 COND(X) = 154.69
LHS MEAN = 145.24100 SR = 0.0016

COEF	VALUE	ST ER	T-STAT	MEAN
NT1BF2.0	28.43300	12.12050	2.34585	1.00000
NT1BF2.1	-3.41089	4.52240	-0.75422	0.25000
NT1BF2.2	-13.98160	4.69082	-2.98063	0.25000
NT1BF2.3	1.27122	4.51123	0.28179	0.25000
NT1BF2.4	-2.48856	0.88044	-2.82648	85.03490
NT1BF2.5	2.45359	0.89161	2.75187	87.80180
NT1BF2.6	0.80642	0.07966	10.12360	145.11300

20: RPBF3 = RPBF3.0+RPBF3.1*(WPSS1+WPSS2)/2+RPBF3.2*(0.2*WA3+PBOIL3)+RPBF3.3*(IBF1(-1)+IBF2(-1))+RPBF3.4*ER34+RPBF3.5*RPBF3(-1)

NOB = 44 NOVAR = 6
RANGE = 1970 1 TO 1980 4
RSQ = 0.99619 CRSQ = 0.99569 F(5/38) = 1989.370
SER = 4.1305 SSR = 648.312 DW(0) = 1.93 COND(X) = 88.15
LHS MEAN = 158.20100 SR = 0.00284

COEF	VALUE	ST ER	T-STAT	MEAN
RPBF3.0	-118.93600	15.01440	-7.92148	1.00000
RPBF3.1	1.13213	0.09667	11.71130	86.41830
RPBF3.2	0.05746	0.11500	0.49969	49.76430
RPBF3.3	-0.03008	0.05487	-0.54811	64.47810
RPBF3.4	107.98400	16.23580	6.65100	1.05189
RPBF3.5	0.42209	0.04730	8.92434	153.50500

21: RPBF3 = PCBF3.0+PCBF3.1*JS1+PCBF3.2*JS2+PCBF3.3*JS3+PCBF3.4*PCDBF3+PCBF3.5*RPBF3(-1)+PCBF3.6*RPPK3+PCBF3.7*PCDY3

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4

```
RSQ =   0.98968      CRSQ =   0.98767      F(7/36) =   493.231
SER =   6.9879       SSR =  1757.890       DW(0) =  1.38      COND(X) =    92.16
LHS MEAN =     158.20100      SR =       0.00081

COEF            VALUE           ST ER          T-STAT          MEAN

PCBF3.0      150.50300       25.86300        5.81924       1.00000
PCBF3.1        3.54952        3.00297        1.18200       0.25000
PCBF3.2        3.97286        3.16676        1.25455       0.25000
PCBF3.3        5.26368        3.37033        1.56177       0.25000
PCBF3.4       -8.32334        1.29515       -6.42652      20.83650
PCBF3.5        0.53642        0.08223        6.52357     153.50500
PCBF3.6        0.18975        0.06689        2.83673     179.13900
PCBF3.7        0.04965        0.01291        3.84518    1240.67000
```

```
22:  IBF2 = IBF2.0+IBF2.1*JS1+IBF2.2*JS2+IBF2.3*JS3+IBF2.4*QBF2+IBF2.5*IBF2(-1)

NOB = 44      NOVAR = 6
RANGE =  1970 1 TO 1980 4
RSQ =   0.61766      CRSQ =   0.56735      F(5/38) =    12.277
SER =   9.2375       SSR =  3242.600       DW(0) =  1.70      COND(X) =    39.34
LHS MEAN =      52.49860      SR =       0.00029

COEF            VALUE           ST ER          T-STAT          MEAN

IBF2.0       -28.39270       18.93300       -1.49964       1.00000
IBF2.1        -3.60896        4.47102       -0.80719       0.25000
IBF2.2        -9.69772        3.99796       -2.42567       0.25000
IBF2.3       -10.27750        3.94725       -2.60371       0.25000
IBF2.4         0.34313        0.11955        2.87018     176.21100
IBF2.5         0.50620        0.12517        4.04425      52.00170
```

```
23:  PSS2-PSS2(-1) = PSS2.0+PSS2.1*JS1+PSS2.2*JS2+PSS2.3*JS3+PSS2.4*(WPSS2-WPSS2(-1))+PSS2.5*(
DSS2-DSS2(-1))+PSS2.6*(WAPK3-WAPK3(-1))+PSS2.7*(VBBF4-VBBF4(-1))

NOB = 44      NOVAR = 8
RANGE =  1970 1 TO 1980 4
RSQ =   0.97826      CRSQ =   0.97403      F(7/36) =   231.364
SER =   0.6903       SSR =    17.152       DW(0) =  2.30      COND(X) =     6.17
LHS MEAN =       1.24386      SR =       0.00003

COEF            VALUE           ST ER          T-STAT          MEAN

PSS2.0        -0.30102        0.24922       -1.20785       1.00000
PSS2.1         0.27963        0.31166        0.89722       0.25000
PSS2.2         1.61638        0.53527        3.01972       0.25000
PSS2.3         0.42678        0.30111        1.41733       0.25000
PSS2.4         0.57768        0.02112       27.35550       2.12629
PSS2.5        -0.02570        0.00808       -3.17852       0.29368
```

PSS2.6	-0.07181	0.02843	-2.52598	4.99416
PSS2.7	0.37955	0.06712	5.65486	0.26894

24: PHF2-PHF2(-1) = PHF2.0+PHF2.1*JS1+PHF2.2*JS2+PHF2.3*JS3+PHF2.4*(WPSS2-WPSS2(-1))+PHF2.5*(DHF2-DHF2(-1))+PHF2.6*(WAPK3-WAPK3(-1))+PHF2.7*(VBBF4-VBBF4(-1))

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.9658 CRSQ = 0.95915 F(7/36) = 145.229
SER = 0.8451 SSR = 25.714 DW(0) = 2.18 COND(X) = 4.94
LHS MEAN = 1.17242 SR = 0.00002

COEF	VALUE	ST ER	T-STAT	MEAN
PHF2.0	0.66515	0.28527	2.33165	1.00000
PHF2.1	-0.08615	0.37358	-0.23060	0.25000
PHF2.2	0.28655	0.43782	0.65450	0.25000
PHF2.3	-1.00672	0.43511	-2.31370	0.25000
PHF2.4	0.52455	0.02711	19.34640	2.12629
PHF2.5	-0.04077	0.02116	-1.92650	0.61761
PHF2.6	-0.10136	0.03511	-2.88705	4.99416
PHF2.7	0.46443	0.08215	5.65376	0.26894

25: PBW2 = PBW2.0+PBW2.1*JS1+PBW2.2*JS2+PBW2.3*JS3+PBW2.4*WPSS2+PBW2.5*DBW2+PBW2.6*WAPK3+PBW2.7*VBBF4+PBW2.8*PBW2(-1)

NOB = 44 NOVAR = 9
RANGE = 1970 1 TO 1980 4
RSQ = 0.96325 CRSQ = 0.95484 F(8/35) = 114.658
SER = 2.8573 SSR = 285.744 DW(0) = 1.57 COND(X) = 47.95
LHS MEAN = 33.80030 SR = 0.00105

COEF	VALUE	ST ER	T-STAT	MEAN
PBW2.0	-10.84140	5.80313	-1.86819	1.00000
PBW2.1	5.72402	1.60608	3.56398	0.25000
PBW2.2	4.64013	1.66703	2.78347	0.25000
PBW2.3	1.55352	1.47411	1.05387	0.25000
PBW2.4	0.13051	0.06278	2.07883	87.80180
PBW2.5	0.07828	0.05575	1.40417	83.72970
PBW2.6	-0.03444	0.01709	-2.01541	224.75700
PBW2.7	0.83826	0.21696	3.86366	11.91290
PBW2.8	0.64749	0.12104	5.34957	33.05540

26: SSS2 = SSS2.0+SSS2.1*JS1+SSS2.2*JS2+SSS2.3*JS3+SSS2.4*PSS2(-8)+SSS2.5*FPC02(-9)+SSS2.6*PFC2(-7)+SSS2.7*SSS2(-1)+SSS2.8*D19734+SSS2.9*ISS2(-1)+SSS2.10*D19742

```
NOB = 44      NOVAR = 11
RANGE =  1970 1 TO 1980 4
RSQ =    0.84044      CRSQ =    0.79208      F(10/33) =     17.381
SER =   12.7335       SSR =   5350.710       DW(0) =   1.92      COND(X) =     76.49
LHS MEAN =     133.45600      SR =       0.00626

COEF          VALUE          ST ER          T-STAT          MEAN

SSS2.0      138.83700      41.09570        3.37839       1.00000
SSS2.1       -3.28600       7.79627       -0.42148       0.25000
SSS2.2       41.18900       6.66517        6.17973       0.25000
SSS2.3       23.82860       8.35747        2.85117       0.25000
SSS2.4        2.25225       0.60808        3.70389      41.42700
SSS2.5       -0.07962       0.16507       -0.48232      75.75700
SSS2.6       -0.96671       0.33338       -2.89973      46.14570
SSS2.7        0.15819       0.12533        1.26215     133.05700
SSS2.8      -26.43770      13.82110       -1.91286       0.02273
SSS2.9       -0.11508       0.05397       -2.13232     741.30500
SSS2.10      60.80730      14.01820        4.33772       0.02273
```

```
27:  SHF2 = SHF2.0+SHF2.1*JS1+SHF2.2*JS2+SHF2.3*JS3+SHF2.4*FPC02(-9)+SHF2.5*IHF2(-1)+SHF2.6*SHF2(
-1)+SHF2.7*PHF2(-8)+SHF2.8*D19734+SHF2.9*D19742
```

```
NOB = 44      NOVAR = 10
RANGE =  1970 1 TO 1980 4
RSQ =    0.90499      CRSQ =    0.87985      F(9/34) =     35.986
SER =    5.4491       SSR =   1009.550       DW(0) =   1.99      COND(X) =     52.68
LHS MEAN =     65.17910      SR =       0.00128

COEF          VALUE          ST ER          T-STAT          MEAN

SHF2.0      -15.12790       9.73066       -1.55466       1.00000
SHF2.1        6.58826       2.70529        2.43532       0.25000
SHF2.2       -2.19021       2.46840       -0.88730       0.25000
SHF2.3       -0.79278       2.81903       -0.28123       0.25000
SHF2.4        0.12723       0.05657        2.24907      75.75700
SHF2.5        0.07567       0.03612        2.09530     411.78600
SHF2.6        0.59083       0.09431        6.26502      64.63920
SHF2.7        0.01069       0.16896        0.06327      38.40280
SHF2.8       -7.77232       5.88625       -1.32042       0.02273
SHF2.9        7.97182       5.96107        1.33731       0.02273
```

```
28:  SBW2 = SBW2.0+SBW2.1*JS1+SBW2.2*JS2+SBW2.3*JS3+SBW2.4*SBW2(-1)+SBW2.5*IBW2(-1)+SBW2.6*PFC2(
-1)+SBW2.7*PHG2(-1)
```

```
NOB = 60      NOVAR = 8
RANGE =  1966 1 TO 1980 4
```

```
RSQ =    0.74185      CRSQ =    0.7071       F(7/52) =     21.348
SER =    8.2747       SSR =   3560.480       DW(0) =   1.79      COND(X) =     37.53
LHS MEAN =      85.58850      SR =        0.00116

COEF            VALUE            ST ER          T-STAT          MEAN

SBW2.0        41.83140        12.04730         3.47227       1.00000
SBW2.1       -27.33230         3.52377        -7.75654       0.25000
SBW2.2       -18.22600         3.04191        -5.99164       0.25000
SBW2.3       -14.04070         3.10817        -4.51736       0.25000
SBW2.4         0.60380         0.09077         6.65181      86.36240
SBW2.5         0.00619         0.01402         0.44149     749.04900
SBW2.6        -0.17653         0.07333        -2.40724      48.08040
SBW2.7         0.21787         0.13273         1.64143      47.56310
```

29: ISS2 = ISS2.0+ISS2.1*SSS2+ISS2.2*ISS2(-1)+ISS2.3*IBW2(-9)+ISS2.4*JS1+ISS2.5*JS2+ISS2.6*JS3+ISS2.7*PFC2(-7)+ISS2.8*FPC02(-2)+ISS2.9*D19742

```
NOB = 44      NOVAR = 10
RANGE =  1970 1 TO 1980 4
RSQ =    0.93813      CRSQ =    0.92175      F(9/34) =     57.282
SER =   20.1028       SSR = 13740.100        DW(0) =   1.57      COND(X) =     84.24
LHS MEAN =     742.08000      SR =        0.01074

COEF            VALUE            ST ER          T-STAT          MEAN

ISS2.0       124.92800        66.95160         1.86594       1.00000
ISS2.1        -0.46387         0.22367        -2.07387     133.45600
ISS2.2         0.74027         0.09902         7.47628     741.30500
ISS2.3         0.02513         0.04802         0.52335     779.93900
ISS2.4       136.44100        11.67180        11.68980       0.25000
ISS2.5       176.15400        13.45660        13.09050       0.25000
ISS2.6        32.25780        13.52800         2.38452       0.25000
ISS2.7        -0.06632         0.31936        -0.20765      46.14570
ISS2.8         0.30825         0.21983         1.40220      85.78140
ISS2.9        48.10290        24.57910         1.95707       0.02273
```

30: IHF2 = IHF2.0+IHF2.1*SHF2+IHF2.2*IHF2(-1)+IHF2.3*IBW2(-12)+IHF2.4*JS1+IHF2.5*JS2+IHF2.6*JS3+IHF2.7*PFC2(-9)+IHF2.8*PHF2(-1)

```
NOB = 44      NOVAR = 9
RANGE =  1970 1 TO 1980 4
RSQ =    0.94302      CRSQ =    0.93         F(8/35) =     72.409
SER =   14.1012       SSR =   6959.550       DW(0) =   1.32      COND(X) =     64.14
LHS MEAN =     415.21300      SR =        0.02441

COEF            VALUE            ST ER          T-STAT          MEAN

IHF2.0       -23.06030        23.91070        -0.96443       1.00000
```

IHF2.1	-1.10664	0.33248	-3.32844	65.17910
IHF2.2	0.79920	0.10712	7.46099	411.78600
IHF2.3	0.15138	0.05199	2.91154	765.78100
IHF2.4	71.47560	7.76012	9.21064	0.25000
IHF2.5	72.88170	6.40432	11.38010	0.25000
IHF2.6	5.42354	6.93397	0.78217	0.25000
IHF2.7	0.47907	0.34663	1.38209	43.38950
IHF2.8	0.15483	0.20304	0.76254	46.16600

31: IBW2 = IBW2.0+IBW2.1*JS1+IBW2.2*JS2+IBW2.3*JS3+IBW2.4*PHF2(-3)+IBW2.5*PFC2(-3)+IBW2.6*FPCO2(-3)+IBW2.7*IBW2(-1)+IBW2.8*(SHF2(-6)/SSS2(-6))+IBW2.9*SBW2

NOB = 74 NOVAR = 10
RANGE = 1963 1 TO 1981 2
RSQ = 0.99059 CRSQ = 0.98927 F(9/64) = 748.563
SER = 12.3741 SSR = 9799.640 DW(0) = 1.19 COND(X) = 62.45
LHS MEAN = 725.35700 SR = 0.06543

COEF	VALUE	ST ER	T-STAT	MEAN
IBW2.0	24.50670	15.94530	1.53692	1.00000
IBW2.1	26.24490	5.03538	5.21209	0.25676
IBW2.2	27.69020	6.26845	4.41740	0.25676
IBW2.3	-4.97361	6.15359	-0.80825	0.24324
IBW2.4	-1.99832	0.61830	-3.23196	37.66500
IBW2.5	1.32086	0.38476	3.43296	43.76340
IBW2.6	-0.04804	0.14534	-0.33052	74.46140
IBW2.7	1.04401	0.01769	59.02460	724.04600
IBW2.8	-21.35020	23.66920	-0.90203	0.44613
IBW2.9	-0.42883	0.12590	-3.40607	86.59550

32: PFC2 = PFC2.0+PFC2.1*JS1+PFC2.2*JS2+PFC2.3*JS3+PFC2.4*PSS2(-1)+PFC2.5*FPCO2(-1)+PFC2.6*PFC2(-1)

NOB = 44 NOVAR = 7
RANGE = 1970 1 TO 1980 4
RSQ = 0.92387 CRSQ = 0.91152 F(6/37) = 74.832
SER = 6.0778 SSR = 1366.770 DW(0) = 2.11 COND(X) = 37.97
LHS MEAN = 55.14030 SR = 0.00035

COEF	VALUE	ST ER	T-STAT	MEAN
PFC2.0	6.32415	3.84573	1.64446	1.00000
PFC2.1	-0.27158	2.64265	-0.10277	0.25000
PFC2.2	-1.22705	2.63683	-0.46535	0.25000
PFC2.3	-3.36889	2.61328	-1.28914	0.25000
PFC2.4	0.50297	0.24845	2.02438	49.43070
PFC2.5	-0.15215	0.06509	-2.33768	87.69650
PFC2.6	0.71160	0.15445	4.60723	54.12330

39: NTHF1 = NTHF1.0+NTHF1.1*JS1+NTHF1.2*JS2+NTHF1.3*JS3+NTHF1.4*ER34+NTHF1.5*PHF4+NTHF1.6*PHF1+
NTHF1.7*NTHF1(-1)

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.29194 CRSQ = 0.15426 F(7/36) = 2.120
SER = 11.7914 SSR = 5005.310 DW(0) = 2.07 COND(X) = 84.22
LHS MEAN = 7.87232 SR = -0.00134

COEF	VALUE	ST ER	T-STAT	MEAN
NTHF1.0	7.01495	42.84640	0.16372	1.00000
NTHF1.1	4.94997	5.21887	0.94848	0.25000
NTHF1.2	2.77044	5.20706	0.53206	0.25000
NTHF1.3	-0.15681	5.28712	-0.02966	0.25000
NTHF1.4	-16.19950	46.79430	-0.34619	1.05189
NTHF1.5	0.89016	0.66319	1.34225	44.15460
NTHF1.6	-0.60192	0.56052	-1.07386	44.54040
NTHF1.7	0.44755	0.14419	3.10391	7.84570

40: NTSS1 = NTSS1.0+NTSS1.1*JS1+NTSS1.2*JS2+NTSS1.3*JS3+NTSS1.4*ER34+NTSS1.5*PSS4+NTSS1.6*PSS1+
NTSS1.7*NTSS1(-1)

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.38169 CRSQ = 0.26146 F(7/36) = 3.175
SER = 10.7141 SSR = 4132.540 DW(0) = 1.76 COND(X) = 78.56
LHS MEAN = 9.82866 SR = 0.0006

COEF	VALUE	ST ER	T-STAT	MEAN
NTSS1.0	3.31074	35.31380	0.09375	1.00000
NTSS1.1	9.09892	4.96748	1.83170	0.25000
NTSS1.2	4.48131	4.86224	0.92166	0.25000
NTSS1.3	15.63510	5.00864	3.12162	0.25000
NTSS1.4	-0.43131	40.22690	-0.01072	1.05189
NTSS1.5	0.25309	0.67819	0.37318	45.00070
NTSS1.6	-0.33552	0.56786	-0.59085	47.64200
NTSS1.7	0.39980	0.14734	2.71346	10.66420

41: NTBW1 = NTBW1.0+NTBW1.1*JS1+NTBW1.2*JS2+NTBW1.3*JS3+NTBW1.4*ER34+NTBW1.5*PBW4+NTBW1.6*PBW1+
NTBW1.7*NTBW1(-1)

NOB = 44 NOVAR = 8

```
RANGE =  1970 1 TO 1980 4
RSQ =    0.65956      CRSQ =    0.59337      F(7/36) =      9.964
SER =    7.0080       SSR =   1768.030       DW(0) =   1.83      COND(X) =     89.62
LHS MEAN =       9.30127      SR =      -0.00054

COEF            VALUE          ST ER          T-STAT          MEAN

NTBW1.0      -42.34420       25.92970       -1.63304        1.00000
NTBW1.1      -13.18160        3.27051       -4.03043        0.25000
NTBW1.2      -11.80910        3.12255       -3.78188        0.25000
NTBW1.3       -7.32662        3.05966       -2.39459        0.25000
NTBW1.4       55.31420       27.63440        2.00164        1.05189
NTBW1.5        2.00657        0.75474        2.65863       30.18920
NTBW1.6       -1.94882        0.63233       -3.08198       32.31330
NTBW1.7        0.42735        0.12894        3.31440        9.21145
```

```
42:  NT1BF4 = NT1BF4.0+NT1BF4.1*JS1+NT1BF4.2*JS2+NT1BF4.3*JS3+NT1BF4.4*ER34+NT1BF4.5*WPSS1+
NT1BF4.6*WPSS4+NT1BF4.7*NT1BF4(-1)
```

```
NOB = 41      NOVAR = 8
RANGE =  1970 1 TO 1980 4
RSQ =    0.39135      CRSQ =    0.273        F(7/36) =      3.307
SER =    2.6164       SSR =   246.433        DW(0) =   1.95      COND(X) =     87.03
LHS MEAN =       3.28931      SR =       0.0006

COEF            VALUE          ST ER          T-STAT          MEAN

NT1BF4.0     -15.91420        9.46994       -1.68050        1.00000
NT1BF4.1       0.68411        1.14865        0.59557        0.25000
NT1BF4.2      -0.35565        1.20694       -0.29467        0.25000
NT1BF4.3      -0.90708        1.17193       -0.77401        0.25000
NT1BF4.4      18.85030       10.72220        1.75807        1.05189
NT1BF4.5      -0.05136        0.07212       -0.71218       85.03490
NT1BF4.6       0.03456        0.10495        0.32931       72.39440
NT1BF4.7       0.42069        0.15490        2.71586        3.29245
```

```
43:  NTHF2 = NTHF2.0+NTHF2.1*JS1+NTHF2.2*JS2+NTHF2.3*JS3+NTHF2.4*ER34+NTHF2.5*PHF4+NTHF2.6*PHF2+
NTHF2.7*NTHF2(-1)
```

```
NOB = 44      NOVAR = 8
RANGE =  1970 1 TO 1980 4
RSQ =    0.47542      CRSQ =    0.37342      F(7/36) =      4.661
SER =    5.1237       SSR =   945.073        DW(0) =   1.75      COND(X) =     88.26
LHS MEAN =      -2.40789      SR =      -0.00047

COEF            VALUE          ST ER          T-STAT          MEAN

NTHF2.0      -35.04080       20.03120       -1.74932        1.00000
NTHF2.1        0.82124        2.22895        0.36844        0.25000
```

NTHF2.2	3.86602	2.36203	1.63673	0.25000
NTHF2.3	-5.22851	2.55680	-2.04494	0.25000
NTHF2.4	31.54610	21.29100	1.48166	1.05189
NTHF2.5	0.48085	0.32862	1.46324	44.15460
NTHF2.6	-0.43610	0.26923	-1.61984	47.33850
NTHF2.7	0.43003	0.15094	2.84912	-2.33011

44: NTSS2 = NTSS2.0+NTSS2.1*JS1+NTSS2.2*JS2+NTSS2.3*JS3+NTSS2.4*ER34+NTSS2.5*PSS4+NTSS2.6*PSS2+ NTSS2.7*NTSS2(-1)

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.57595 CRSQ = 0.49349 F(7/36) = 6.985
SER = 14.0130 SSR = 7069.120 DW(0) = 1.43 COND(X) = 100.55
LHS MEAN = -23.05020 SR = 0.00012

COEF	VALUE	ST ER	T-STAT	MEAN
NTSS2.0	-160.55000	60.16940	-2.66830	1.00000
NTSS2.1	10.90900	6.38184	1.70937	0.25000
NTSS2.2	21.11170	6.55637	3.22002	0.25000
NTSS2.3	3.14914	6.64558	0.47387	0.25000
NTSS2.4	133.54700	62.20590	2.14686	1.05189
NTSS2.5	1.47957	0.98458	1.50274	45.00070
NTSS2.6	-1.37429	0.79938	-1.71919	50.67450
NTSS2.7	0.37610	0.15883	2.36796	-23.15540

45: NTBW2 = NTBW2.0+NTBW2.1*JS1+NTBW2.2*JS2+NTBW2.3*JS3+NTBW2.4*ER34+NTBW2.5*PBW4+NTBW2.6*PBW2+ NTBW2.7*NTBW2(-1)

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.7532 CRSQ = 0.70522 F(7/36) = 15.696
SER = 2.5009 SSR = 225.170 DW(0) = 1.98 COND(X) = 102.41
LHS MEAN = 3.02252 SR = 0.00037

COEF	VALUE	ST ER	T-STAT	MEAN
NTBW2.0	-21.58760	10.58710	-2.03904	1.00000
NTBW2.1	-1.03365	1.08531	-0.95240	0.25000
NTBW2.2	0.40153	1.10978	0.36181	0.25000
NTBW2.3	-3.29216	1.13093	-2.91102	0.25000
NTBW2.4	20.41200	10.69810	1.90801	1.05189
NTBW2.5	0.79174	0.29005	2.72966	30.18920
NTBW2.6	-0.63837	0.22449	-2.84370	33.80030
NTBW2.7	0.59979	0.12306	4.87407	2.99289

```
46:  NT2BF4 = NT2BF4.0+NT2BF4.1*JS1+NT2BF4.2*JS2+NT2BF4.3*JS3+NT2BF4.4*ER34+NT2BF4.5*MPSS2+
NT2BF4.6*MPSS4+NT2BF4.7*NT2BF4(-1)


NOB = 44      NOVAR = 8
RANGE =  1970 1 TO 1980 4
RSQ =   0.4079       CRSQ =   0.29277      F(7/36) =      3.543
SER =   6.5718       SSR =  1554.800       DW(0) =  2.26      COND(X) =     84.88
LHS MEAN =      13.22190      SR =      -0.00007

COEF            VALUE          ST ER          T-STAT          MEAN

NT2BF4.0     -39.61610       22.21570       -1.78325       1.00000
NT2BF4.1       5.08634        2.90187        1.75278       0.25000
NT2BF4.2       4.21831        3.02777        1.39321       0.25000
NT2BF4.3       4.66736        2.95078        1.58174       0.25000
NT2BF4.4      41.96340       26.94780        1.55721       1.05189
NT2BF4.5      -0.15455        0.20764       -0.74432      87.80180
NT2BF4.6       0.17698        0.31862        0.55547      72.39440
NT2BF4.7       0.44954        0.16336        2.75189      13.26200
```

1: IPK1 = IPK1.0+IPK1.1*JS1+IPK1.2*JS2+IPK1.3*JS3+IPK1.4*QPK1+IPK1.5*IPK1(-1)+IPK1.6*D19712

NOB = 44 NOVAR = 7
RANGE = 1970 1 TO 1980 4
RSQ = 0.76712 CRSQ = 0.72936 F(6/37) = 20.313
SER = 2.6250 SSR = 254.946 DW(0) = 1.51 COND(X) = 15.14
LHS MEAN = 10.74800 SR = 0.00002

COEF	VALUE	ST ER	T-STAT	MEAN
IPK1.0	0.20339	2.08304	0.09764	1.00000
IPK1.1	2.69714	1.13131	2.38409	0.25000
IPK1.2	-0.16094	1.22230	-0.13167	0.25000
IPK1.3	-4.01564	1.26154	-3.18312	0.25000
IPK1.4	0.04022	0.01994	2.01708	115.72700
IPK1.5	0.56352	0.10636	5.29826	10.73510
IPK1.6	9.27340	2.90601	3.19112	0.02273

2: CWHG1 = CWHG1.0+CWHG1.1*JS1+CWHG1.2*JS2+CWHG1.3*JS3+CWHG1.4*PHG1(-1)+CWHG1.5*OPBA3(-3)+
CWHG1.6*CWHG1(-1)

NOB = 44 NOVAR = 7
RANGE = 1970 1 TO 1980 4
RSQ = 0.74668 CRSQ = 0.7056 F(6/37) = 18.176
SER = 1.0767 SSR = 42.891 DW(0) = 2.05 COND(X) = 255.17
LHS MEAN = 134.17300 SR = 0.00035

COEF	VALUE	ST ER	T-STAT	MEAN
CWHG1.0	49.79330	13.49040	3.69102	1.00000
CWHG1.1	-1.46887	0.48358	-3.03750	0.25000
CWHG1.2	-1.28053	0.46869	-2.73217	0.25000
CWHG1.3	-1.34312	0.47176	-2.84702	0.25000
CWHG1.4	0.05142	0.01631	3.15210	49.53690
CWHG1.5	-0.01809	0.00815	-2.22063	65.82180
CWHG1.6	0.62657	0.10288	6.09005	134.13800

3: IHG1 = IHG1.0+IHG1.1*JS1+IHG1.2*JS2+IHG1.3*JS3+IHG1.4*PHG1(-2)+IHG1.5*OPBA3(-2)+IHG1.6*JS3*
FIGR3+IHG1.7*IHG1(-1)

NOB = 56 NOVAR = 8
RANGE = 1967 1 TO 1980 4
RSQ = 0.97915 CRSQ = 0.97611 F(7/48) = 321.975
SER = 87.4114 SSR = 3.668E+05 DW(0) = 0.84 COND(X) = 26.53

```
LHS MEAN =    2802.38000      SR =        0.0144

COEF            VALUE          ST ER          T-STAT          MEAN

IHG1.0       316.12600       98.22780        3.21830       1.00000
IHG1.1       -77.48480       33.38600       -2.32088       0.25000
IHG1.2       -81.33540       33.29190       -2.44310       0.25000
IHG1.3      -155.99900      195.88900       -0.79636       0.25000
IHG1.4         4.93504        1.00177        4.92631      44.34630
IHG1.5        -4.52564        0.63646       -7.11062      61.66190
IHG1.6         4.85748        5.38264        0.90244       8.99852
IHG1.7         0.92469        0.02494       37.07830    2791.71000
```

```
4:  SHG1 = SHG1.0+SHG1.1*JS1+SHG1.2*JS2+SHG1.3*JS3+SHG1.4*IHG1(-1)+SHG1.5*SHG1(-1)

NOB = 44      NOVAR = 6
RANGE =  1970 1 TO 1980 4
RSQ =    0.94261      CRSQ =    0.93506      F(5/38) =    124.832
SER =   50.8335       SSR =  98193.600       DW(0) =   1.93      COND(X) =    27.73
LHS MEAN =     880.49000      SR =        0.0144

COEF            VALUE          ST ER          T-STAT          MEAN

SHG1.0       -43.80070       39.85240       -1.09907       1.00000
SHG1.1        83.12170       21.70260        3.83003       0.25000
SHG1.2        61.86710       22.93640        2.69733       0.25000
SHG1.3       -32.65590       23.61640       -1.38276       0.25000
SHG1.4         0.18623        0.02760        6.74737    2879.71000
SHG1.5         0.41039        0.08616        4.76308     877.03900
```

```
9:  PHG1 = PHG1.0+PHG1.1*JS1+PHG1.2*JS2+PHG1.3*JS3+PHG1.4*PHG2+PHG1.5*NT1PK2+PHG1.6*PHG1(-1)

NOB = 44      NOVAR = 7
RANGE =  1970 1 TO 1980 4
RSQ =    0.99031      CRSQ =    0.98874      F(6/37) =    630.502
SER =    1.7783       SSR =     117.002      DW(0) =   1.06      COND(X) =    25.20
LHS MEAN =      50.31280      SR =       -0.00003

COEF            VALUE          ST ER          T-STAT          MEAN

PHG1.0        -1.05376        2.58012       -0.40841       1.00000
PHG1.1         0.38840        0.76650        0.50672       0.25000
PHG1.2        -0.34284        0.77253       -0.44379       0.25000
PHG1.3         0.19957        0.81554        0.24471       0.25000
PHG1.4         0.90725        0.04516       20.09180      53.47580
PHG1.5        -0.07027        0.03302       -2.12840      26.66820
PHG1.6         0.09414        0.04619        2.03789      49.53690
```

```
10:  RPPK3 = RPPK3.0+RPPK3.1*JS1*PHG2+RPPK3.2*JS2*PHG2+RPPK3.3*JS3*PHG2+RPPK3.4*PHG2+RPPK3.5*(0.2
*WAPK3+PBOIL3)+RPPK3.6*ER34+RPPK3.7*(IPK1(-1)+IPK2(-1))+RPPK3.8*RPPK3(-1)


NOB = 44      NOVAR = 9
RANGE =  1970 1 TO 1980 4
RSQ =   0.99764      CRSQ =   0.99711      F(8/35) =  1852.870
SER =   2.7611       SSR =   266.825       DW(0) =  1.83      COND(X) =    99.42
LHS MEAN =    179.13900      SR =      -0.00038

COEF          VALUE          ST ER          T-STAT          MEAN

RPPK3.0     -46.80140       11.12850       -4.20554        1.00000
RPPK3.1      -0.06180        0.02145       -2.88066       13.01730
RPPK3.2      -0.09436        0.02320       -4.06690       12.59090
RPPK3.3       0.00966        0.02300        0.42007       14.08610
RPPK3.4       1.25198        0.06387       19.60360       53.47580
RPPK3.5       0.66512        0.08530        7.79752       52.81450
RPPK3.6      55.69010       10.88610        5.11571        1.05189
RPPK3.7      -0.05795        0.06863       -0.84448       27.12510
RPPK3.8       0.39054        0.03382       11.54770      175.93800


11:  RPPK3 = PCPK3.0+PCPK3.1*JS1+PCPK3.2*JS2+PCPK3.3*JS3+PCPK3.4*PCDPK3+PCPK3.5*RPBF3+PCPK3.6*
PCDY3+PCPK3.7*RPNF3+PCPK3.8*RPCK3


NOB = 44      NOVAR = 9
RANGE =  1970 1 TO 1980 4
RSQ =   0.98649      CRSQ =   0.9834       F(8/35) =   319.479
SER =   6.6121       SSR =  1530.200       DW(0) =  1.18      COND(X) =    159.62
LHS MEAN =    179.13900      SR =       0.00125

COEF          VALUE          ST ER          T-STAT          MEAN

PCPK3.0     179.09400       27.47460        6.51855        1.00000
PCPK3.1      -2.40290        2.99115       -0.80334        0.25000
PCPK3.2     -13.88100        3.28259       -4.22868        0.25000
PCPK3.3     -12.85420        5.30898       -2.42122        0.25000
PCPK3.4     -14.00190        1.53785       -9.10484       13.47670
PCPK3.5       0.18181        0.06759        2.68972      158.20100
PCPK3.6       0.01698        0.02749        0.61775     1240.67000
PCPK3.7       0.78406        0.33317        2.35330      135.52100
PCPK3.8       0.22813        0.11548        1.97542      175.06300


12:  IPK2 = IPK2.0+IPK2.1*JS1+IPK2.2*JS2+IPK2.3*JS3+IPK2.4*QPK2+IPK2.5*IPK2(-1)+IPK2.6*D19712


NOB = 44      NOVAR = 7
RANGE =  1970 1 TO 1980 4
```

```
RSQ =   0.8165      CRSQ =   0.78674     F(6/37) =    27.438
SER =   1.9584      SSR =    141.908     DW(0) =  2.03     COND(X) =    11.89
LHS MEAN =      16.75660     SR =       0.00019

COEF          VALUE          ST ER          T-STAT          MEAN

IPK2.0        4.20562        1.48604        2.83009        1.00000
IPK2.1        1.57172        0.83902        1.87329        0.25000
IPK2.2       -0.82672        0.91172       -0.90677        0.25000
IPK2.3       -3.06876        0.92617       -3.31336        0.25000
IPK2.4        0.02727        0.00679        4.01594      199.34100
IPK2.5        0.45014        0.08894        5.06113       16.39000
IPK2.6       14.00990        2.11559        6.62220        0.02273
```

```
13:  IHG2 = IHG2.0+IHG2.1*JS1+IHG2.2*JS2+IHG2.3*JS3+IHG2.4*PHG2(-2)+IHG2.5*FPCO2(-2)+IHG2.6*RFC3(
-2)+IHG2.7*DQUE

NOB = 44      NOVAR = 8
RANGE =  1970 1 TO 1980 4
RSQ =   0.98648      CRSQ =   0.98385     F(7/36) =   375.296
SER = 138.8370       SSR = 6.939E+05      DW(0) =  0.49     COND(X) =    20.20
LHS MEAN =   4372.23000      SR =       0.1106

COEF          VALUE          ST ER          T-STAT          MEAN

IHG2.0     3730.40000      100.46400       37.13170        1.00000
IHG2.1      -58.06200       59.82670       -0.97050        0.25000
IHG2.2      -61.27410       61.41840       -0.99765        0.25000
IHG2.3       -3.10389       59.72040       -0.05197        0.25000
IHG2.4        8.51669        1.90950        4.46016       52.03740
IHG2.5       -3.98972        1.49624       -2.66650       85.78140
IHG2.6       -7.09315       16.11370       -0.44019        8.32022
IHG2.7        2.89514        0.07839       36.93430      217.78400
```

```
14:  CWHG2 = CWHG2.0+CWHG2.1*JS1+CWHG2.2*JS2+CWHG2.3*JS3+CWHG2.4*PHG2(-1)+CWHG2.5*FPCO2(-3)+
CWHG2.6*CWHG2(-1)

NOB = 44      NOVAR = 7
RANGE =  1970 1 TO 1980 4
RSQ =   0.88046      CRSQ =   0.86108     F(6/37) =    45.421
SER =   0.9650       SSR =    34.456      DW(0) =  2.09     COND(X) =    180.06
LHS MEAN =     133.40300      SR =       0.0002

COEF          VALUE          ST ER          T-STAT          MEAN

CWHG2.0       9.57005        8.43778        1.13419        1.00000
CWHG2.1      -0.25603        0.41839       -0.61194        0.25000
CWHG2.2      -1.74958        0.43220       -4.04805        0.25000
CWHG2.3      -1.59397        0.42132       -3.78325        0.25000
```

CWHG2.4	0.01195	0.01296	0.92234	52.70060
CWHG2.5	-0.00348	0.00697	-0.49960	84.38310
CWHG2.6	0.93338	0.06534	14.28600	133.27600

15: SHG2 = SHG2.0+SHG2.1*JS1+SHG2.2*JS2+SHG2.3*JS3+SHG2.4*IHG2(-1)+SHG2.5*SHG2(-1)

NOB = 44 NOVAR = 6
RANGE = 1970 1 TO 1980 4
RSQ = 0.98663 CRSQ = 0.98487 F(5/38) = 560.852
SER = 43.5005 SSR = 71907.200 DW(0) = 2.02 COND(X) = 49.27
LHS MEAN = 1493.66000 SR = 0.00708

COEF	VALUE	ST ER	T-STAT	MEAN
SHG2.0	49.53230	31.74760	1.56019	1.00000
SHG2.1	-25.26760	20.29930	-1.24475	0.25000
SHG2.2	-79.17400	21.20490	-3.73377	0.25000
SHG2.3	-118.20100	19.67790	-6.00677	0.25000
SHG2.4	0.18954	0.02585	7.33259	4302.35000
SHG2.5	0.46569	0.08167	5.70200	1469.51000

20: PHG1 = PHG1.A+PHG1.B*JS1+PHG1.C*JS2+PHG1.D*JS3+PHG1.E*ER34+PHG1.F*NT1PK4+PHG1.G*PHG4+PHG1.H*PHG1(-1)

NOB = 44 NOVAR = 8
RANGE = 1970 1 TO 1980 4
RSQ = 0.99304 CRSQ = 0.99168 F(7/36) = 733.483
SER = 1.5285 SSR = 84.108 DW(0) = 2.13 COND(X) = 50.61
LHS MEAN = 50.31280 SR = 0.00081

COEF	VALUE	ST ER	T-STAT	MEAN
PHG1.A	-31.23430	3.65375	-8.54855	1.00000
PHG1.B	-1.70557	0.66622	-2.56006	0.25000
PHG1.C	-2.28096	0.66614	-3.42417	0.25000
PHG1.D	-0.73177	0.71533	-1.02298	0.25000
PHG1.E	30.02540	3.72955	8.05066	1.05189
PHG1.F	-0.08603	0.03021	-2.84785	-0.88722
PHG1.G	1.10859	0.04515	24.55140	37.20570
PHG1.H	0.19826	0.03582	5.53460	49.53690

21: PHG2 = PHG2.A+PHG2.B*JS1+PHG2.C*JS2+PHG2.D*JS3+PHG2.E*ER34+PHG2.F*NT2PK4+PHG2.G*PHG4+PHG2.H*PHG2(-1)

NOB = 44 NOVAR = 8

RANGE = 1970 1 TO 1980 4
RSQ = 0.98937 CRSQ = 0.9873 F(7/36) = 478.584
SER = 1.7689 SSR = 112.647 DW(0) = 1.38 COND(X) = 67.31
LHS MEAN = 53.47580 SR = 0.00122

COEF	VALUE	ST ER	T-STAT	MEAN
PHG2.A	-19.82770	5.51845	-3.59299	1.00000
PHG2.B	-1.82963	0.77455	-2.36218	0.25000
PHG2.C	-1.90405	0.76244	-2.49731	0.25000
PHG2.D	-0.34557	0.84206	-0.41039	0.25000
PHG2.E	21.70060	5.75773	3.76895	1.05189
PHG2.F	-0.04179	0.02474	-1.68877	-3.45733
PHG2.G	1.10838	0.05582	19.85670	37.20570
PHG2.H	0.19192	0.04346	4.41558	52.70060